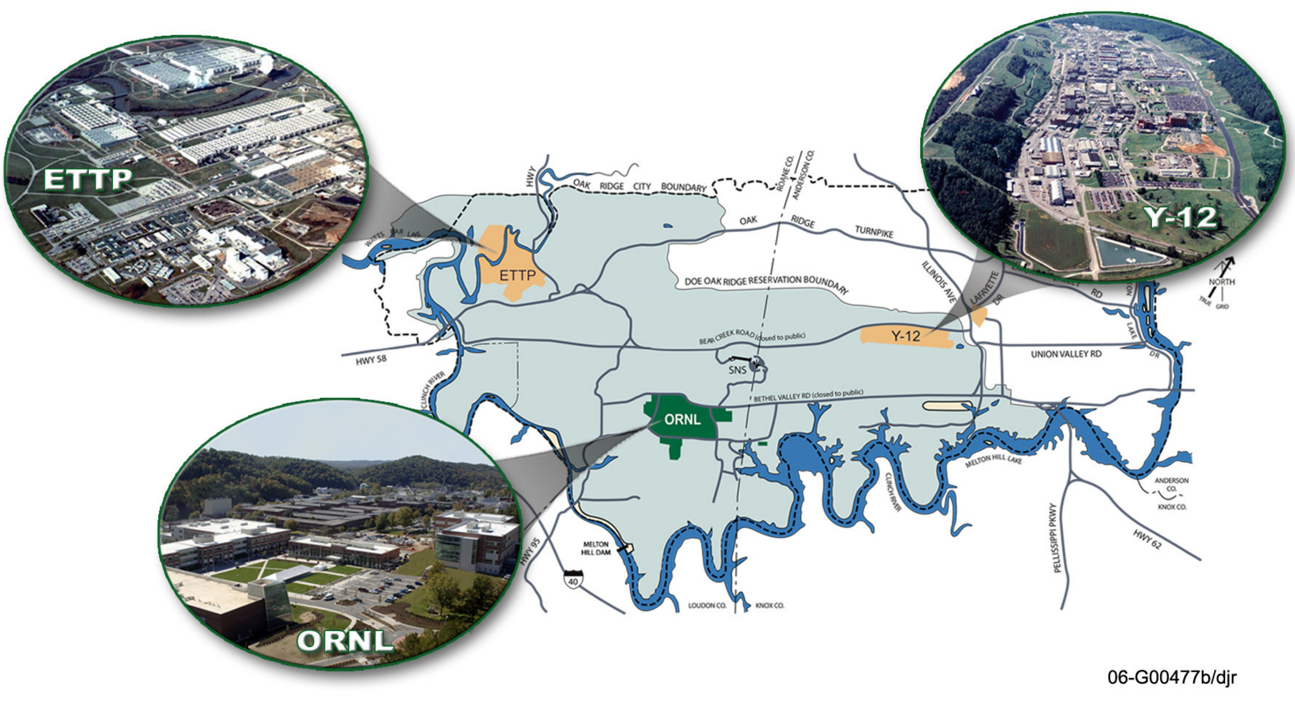
**U.S. Department of Energy**

**Office of Environmental Management (EM)**

**Engineering and Technology**

# External Technical Review (ETR) Report

## Major Risk Factors
## Integrated Facility Disposition Project (IFDP)
## Oak Ridge, TN

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# Acknowledgement

The External Technical Review of the Integrated Facility Disposition Project was conducted simultaneous to other assessments and visits. The ETR Team wishes to note the outstanding support received from all parties involved in the review, including the DOE Oak Ridge Office, the National Nuclear Security Administration Y-12 Site Office, UT-Battelle, B&W Y-12, and the Professional Project Services, Inc. (Pro2Serve). The ETR Team feels compelled to note, and extends its appreciation for, the truly exceptional customer service provided by the Environmental Division of Pro2Serve.

The ETR Team Lead thanks the individual members of the ETR Team, who quickly formed a cohesive Team, and working through nights and weekends, provided a significant value-added perspective to the IFDP.

## EXTERNAL TECHNICAL REVIEW TEAM

**Dr. T.J. Abraham**
**MSE Technology Applications**

**Dr. Vincent Adams**
**Environmental Management, USDOE**
**Deputy Lead**

**Dr. James H. Clarke**
**CRESP/ Vanderbilt University**

**Ms. Yvette T. Collazo**
**Environmental Management, USDOE**
**ETR Lead**

**Dr. Andrew Garrabrants**
**CRESP/ Vanderbilt University**

**Dr. Lynn E. Katz**
**University of Texas at Austin**
**Mercury Issues Lead**

**Dr. Bryan B. Looney**
**Savannah River National Lab.**

**Mr. Peter Maggiore**
**North Wind, Inc.**

**Ms. Julie Mathiesen**
**Trihydro Corporation**
**Document Manager**

**Mr. Richard W. Meehan**
**National Nuclear Security Administration**
**USDOE**

**Dr. Frank L. Parker**
**Vanderbilt University**
**Facility Reconfiguration Lead**

**Dr. J. Winston Porter**
**Waste Policy Center**

**Mr. Richard B. Provencher**
**Idaho Operations Office, USDOE**

**Dr. William C. Schutte**
**MSE Technology Applications**

**Dr. Aníbal L. Taboas**
**Executive Consultant**
**Technical Lead**

**Mr. Doug Turner**
**Visionary Solutions, LLC**

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# Acronyms

| | |
|---|---|
| ALARA | As Low As Reasonably Achievable |
| AMs | Action Memoranda |
| AOC | Area of Concern |
| ARARs | Applicable and Relevant or Appropriate Requirements |
| B | Billion |
| BCV | Bear Creek Valley |
| BSWTS | Big Spring Water Treatment System |
| BV | Bethel Valley |
| BVESTs | Bethel Valley Evaporator Service Tanks |
| CAA | Clean Air Act of 1970, as amended |
| CD | Critical Decision |
| CDR | Conceptual Design Report |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act of 1980 |
| CFR | Code of Federal Regulations |
| CH | contact-handled |
| CMTS | Central Mercury Treatment System |
| COG | central off-gas |
| CWA | Clean Water Act of 1972 |
| D&D | deactivation, decontamination and decommissioning |
| DARA | Disposal Area Remedial Action |
| DOE | Department of Energy |
| DOE O | Order |
| DOT | Department of Transportation |
| DSA | Documented Safety Analysis |
| EE/CA | Engineering Evaluation/Cost Analysis |
| EM | Office of Environmental Management |
| EMWMF | Environmental Management Waste Management Facility |
| EPA | U.S. Environmental Protection Agency |
| ERT | External Review Team |
| ES&H | Environment, Safety, and Health |
| ETEBA | Energy, Technology and Environmental Business Association |
| ETR | External Technical Review |
| ETTP | East Tennessee Technology Park |
| FFA | Federal Facility Agreement |
| FPD | Federal Project Director |
| GW | groundwater |
| IFDP | Integrated Facility Disposition Project |
| IROD | Interim Record of Decision |
| LGWTS | Liquid and Gaseous Waste Treatment System |
| LLW | low-level waste |
| LLLW | liquid low-level waste |
| LTTD | low-temperature thermal desorption |
| MLLW | mixed low-level waste |
| MV | Melton Valley |
| MVNFC | Melton Valley Nuclear Facility Complex |
| MW | mixed waste |
| NCP | National Oil and Hazardous Substances Pollution Contingency Plan |
| NE | Office of Nuclear Energy |

| | |
|---|---|
| NEPA | National Environmental Policy Act of 1969 |
| NESHAP | National Emission Standards for Hazardous Air Pollutants |
| NNSA | National Nuclear Security Administration |
| NPDES | National Pollutant Discharge Elimination System |
| NRWTP | Nonradiological Waste Treatment Plant |
| NPL | National Priorities List |
| NTS | Nevada Test Site |
| ORNL | Oak Ridge National Laboratory |
| ORO | Oak Ridge Office |
| ORR | Oak Ridge Reservation |
| PCBs | polychlorinated biphenyls |
| PEP | Project Execution Plan |
| PIDAS | Perimeter Intrusion Detection and Assessment System |
| PPE | personal protective equipment |
| PPEP | Preliminary Project Execution Plan |
| PWTC | Processed Waste Treatment Complex |
| R&D | research and development |
| RA | Remedial Action |
| RAR | Remedial Action Report |
| RAWP | Remedial Action Work Plan |
| RH | remote-handled |
| RHSPF | Remote-Handled Solids Processing Facility |
| RI/FS | Remedial Investigation/Feasibility Study |
| ROD | Record of Decision |
| RTGs | radioisotope thermo-electric generators |
| SARA | Superfund Amendments and Reauthorization Act |
| SWSA | Solid Waste Storage Area |
| SWMU | Solid Waste Management Unit |
| TDEC | Tennessee Department of Environment and Conservation |
| TMDL | Total Maximum Daily Load |
| TSCA | Toxic Substance Control Act of 1976 |
| TWPC | TRU Waste Processing Center |
| TRU | Transuranic |
| UEFPC | Upper East Fork Poplar Creek |
| WAC | waste acceptance criteria |
| WBS | Work Breakdown Structure |
| WEMA | West End Mercury Area |
| WETF | West End Treatment Facility |
| WHP | Waste Handling Plans |
| WIPP | Waste Isolation Pilot Plant |
| WQC | water quality criteria |
| WWSY | White Wing Scrap Yard |
| Y-12 | Y-12 National Security Complex |

# EXECUTIVE SUMMARY

## BACKGROUND

An External Technical Review (ETR) was conducted, at the request of EM-20 and with concurrence of DOE Oak Ridge Office (OR), in accordance with the "**External Technical Review Charter of Major Risk Factors in the Integrated Facility Disposition Project (IFDP) in Oak Ridge, TN**," dated June 2008. In developing this charter, OR proposed the major risk factors as: (1) Treatment and Disposal of large quantities of Mercury Contaminated Soil and Debris, and (2) Technical Approaches related to Facility Reconfiguration for Radioactive Waste and Low Level Liquid Waste Management. Further, OR submitted a request for Critical Decision (CD) 1 Approval for EM consideration, dated May 30, 2008.

Approximately two million pounds of mercury are unaccounted for at Y-12, potentially resulting in contamination of soil and groundwater. The greatest risk/liability to DOE and the public is transport of mercury to the surface water (East Fork Poplar Creek), which flows off the federal reservation through private property to waters of the State of Tennessee, and its uptake by fish, plants, and other animal life. DOE, regulators, and the public need to have reasonable confidence in the technologies and technical approaches used to remediate this contamination in regards to safety, effectiveness, and environmental stewardship and sustainability.

The mission of IFDP is broad and includes remediation of legacy contamination at the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex. The broad scope includes: 1) facility reconfiguration; 2) D&D (characterization, deactivation, decommissioning, decontamination, demolition, waste management, and disposition of excess facilities and equipment); 3) remediation of contaminated soil, ground and surface water; 4) disposition of legacy materials; and 5) landfill closure, all while addressing regulatory issues and maintaining environmental compliance. Of particular interest are addressing the source term (approximately two million pounds of mercury), potential pathways of contamination to receptors, and overall risk to health, safety, and environment.

## CONDUCT OF THE EXTERNAL TECHNICAL REVIEW

Considering the risk and strategies to address the proposed major risk factors, the ETR was organized into the following three teams: 1) Mercury Related Issues, 2) Facility Related Issues, and 3) Leadership. Team membership consisted of subject matter experts from academia, private consulting, and DOE (external to OR). A description of the overall process employed, established Lines of Inquiry, implementation schedule, list of participants, and Issues and Recommendations appear in detail in the extended report. The process included a factual accuracy review by IFDP staff, and no major unresolved issues exist. Subsequent External Technical Reviews are envisioned as the IFDP progresses through the CD process.

## OBSERVATIONS

This Executive Summary represents the context of deliberations through observations in actionable form. Overall, the ETR Team concluded there were no severe technical issues that would need to be resolved prior to continued programmatic consideration of the IFDP. Several observations were considered "overarching" in that they apply across the IFDP. These are:

- IFDP appears to characterize the overall level of risk in a manner appropriate for the current stage of the project.
- The strategic approach to integrate multiple DOE programs in addressing environmental management issues is commendable.
- Addressing legacy waste and facilities issues as soon as practicable should assist in optimizing the total cost magnitude, risk reduction, and schedule duration.

In addition to the overarching observations, specific observations were made. Specific observations are summarized below.

**Treatment and Disposal of large quantities of Mercury Contaminated Soil, and Debris**

- The current benefits and objectives of the IFDP mercury remediation activities need additional specificity and clarity.
- Goals for mercury remediation should be clearly defined, as the IFDP alone will not "get rid of environmental liabilities."
- There is not a direct linkage between mercury source reduction and emerging stream protection standards.
- Source reduction is a key component of the two primary regulatory drivers currently addressing mercury remediation.
- Significant programmatic risk can be avoided through
  - Aggressive implementation of CERCLA remedial actions;
  - Updating the overall regulatory strategy; and
  - Shipment of mixed low level waste prior to expiration of the ability to dispose at the Nevada Test Site.

**Facility Reconfiguration (e.g.: facilities for radioactive waste processing & management)**

- IFDP has done a commendable job in developing reconfiguration alternatives for ORNL. The technology needed is relatively mature.
- Greater attention must be devoted to the uncertainty of future requirements of the ongoing missions and infrastructure needed to serve them as well as allowing space and easy connections for the utilities and facilities requirements for likely future missions. This might argue for a modular approach.
- Further consideration should be given to the existing and potential upgrades of the capability of the Transuranic Waste Processing Center (TWPC), in lieu of building new Remote Handled Solids processing facilities. Assumptions on the difficulty of satisfying safety basis issues related to the TWPC may be causing an artificial bias toward building new facilities. A "Remote Handled Waste Focus Team" should be created in order to evaluate handling and disposition for "difficult to process" wastes.

- Replacing the Low Level Liquid Waste treatment system for treatment closer to the waste source is a reasonable element of a modular approach unless the economies of scale argue otherwise. Further, the possible use of trenchless technologies could affect that decision.
- Assumption and timing of D&D the hot cells in Bethel Valley and building new ones in Melton Valley as part of the relocation of highly radioactive material processing and disposition from Bethel Valley seems reasonable. However, the existing hot cell facilities might satisfy such needs during the reconfiguration in Bethel Valley. This possibility deserves further consideration.
- While the plan at Y-12 to put in service bypass utilities for the facilities that will remain in service without interruption while D&D of excess facilities is carried out, further thought should be given to other methods of providing service to the remaining facilities (e.g. re-route cooling water lines or install facility specific chillers; re-route compressed air or install a single or multiple stand alone units).

## CONCLUSION

Subject to the aforementioned observations, and with respect to the primary risk factors reviewed, the ETR Team concludes with reasonable confidence that the technical approaches planned to remediate contamination and to carry out the reconfiguration of facilities can be done safely and effectively, and consistent with environmental stewardship.

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# 1.0 INTRODUCTION

The DOE Oak Ridge Office (ORO) and the DOE Environmental Management Office of Engineering and Technology (EM-20) sponsored an External Technical Review (ETR) related to the major risk factors of the planned Integrated Facility Disposition Project (IFDP), in Oak Ridge, TN. This document summarizes the methods utilized to conduct the ETR, and the conclusions and recommendations of the review team.

## 1.1 BACKGROUND – DOE-EM PROJECT REVIEWS

Throughout its existence, DOE-EM has focused on developing and adapting technologies to enhance safety, effectiveness, and efficiency to accomplish its mission of safe and compliant disposition of legacy wastes and facilities from nuclear research and production programs. The DOE Environmental Management Office of Engineering and Technology (DOE EM-20) was established to provide DOE-EM with the strong and responsive applied research and engineering program necessary to address the unique and complex nature of many of its program challenges.

The primary objective of the DOE-EM-20 is to reduce the technical risk and uncertainty in the Department's clean-up programs and projects. These technical risks and uncertainties are identified at the project level, by programmatic and external technical reviews, technical readiness assessments, and by the DOE sites themselves. DOE-EM has initiated external technical reviews (ETRs) as one of several steps to identify technical risks and uncertainties. To ensure the timely resolution of engineering and technology issues, ETR's have been incorporated into applicable stages of the Critical Decision (CD) component of DOE's Acquisition Management System.

### 1.1.1 CRITICAL DECISION PROCESS

The DOE Acquisition Management System, defined and directed by DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, is organized by project phases and Critical Decisions (CD's), which represent a transitioning of broadly stated mission needs into well-defined requirements which result in operationally effective, suitable, and affordable facilities, systems and other products. There are four project phases: Initiation Phase, Definition Phase, Execution Phase, and Transition/Closeout Phase. There are five Critical Decisions (CD's) in the process. The five Critical Decisions are major milestones, each of which marks an increase in commitment of resources by the Department and requires successful completion of the preceding phase or Critical Decision.

- CD-0, Approve Mission Need. CD-0 formally establishes a project and begins the process of conceptual planning and design used to develop alternative concepts and functional requirements.
- CD-1, Approve Alternative Selection and Cost Range. CD-1 provides the authorization to begin the project Execution Phase and allows Project Engineering and Design funds to be used.
- CD-2, Approve Performance Baseline. CD-2 marks the completion of preliminary design, which is the first major milestone in the project Execution Phase.

- CD-3, Approve Start of Construction. CD-3 authorizes the project to commit all the resources necessary, within the funds provided, to execute the project.

- CD-4, Approve Start of Operations or Project Completion. CD-4 marks the achievement of the completion criteria defined in the Project Execution Plan, and approval of transition to operations.

The Integrated Facility Disposition Project (IFDP), in Oak Ridge, TN, components of which are the subject of the ETR presented in this report, is at the CD-1 Approval stage of the Acquisition Management System process.

### 1.1.2 EXTERNAL TECHNICAL REVIEWS

While a number of reviews are required by DOE O 413.3A, ETRs are not specifically required by the Order. However, as stated previously, DOE-EM initiated ETRs as one of several steps to identify and reduce technical risks and/or uncertainties, and ensure their timely resolution. The value of conducting ETRs is recognized throughout DOE-EM, which intends for ETRs to be a mainstay of its program. Therefore, the focus of the ETR is different than the reviews required by DOE O 413.3A. Those reviews are focused on broad-based project management aspects (i.e., scope, cost, and schedule), while ETRs are focused on technical risks and uncertainties.

ETRs are independent reviews conducted by personnel who are not part of the project team implementing the technical scope. ETRs can be conducted at any stage of a project, but the scope of those ETRs will vary depending on the stage of the project. For example, to support Critical Decision (CD)-0, an ETR could be conducted to identify technical risks and the need for new technologies and applied research. To support a CD-1 decision, an ETR of the project's technical alternatives or conceptual design could be conducted. To support CD-2/3, an ETR of the project preliminary and/or final design could be conducted. To support CD-4, an ETR of certain operations or safety issues could be conducted.

Requests for an ETR originate directly from a Program Headquarters (HQ) or Field Office. At that point, HQ or the Field Office will define the general scope and lines of inquiry for the ETR. Requests initiated by the Field Office are routed to DOE EM-20 for approval. The expectation is that Field Offices and Projects will forecast, schedule and fund ETRs as a general policy. EM-20 notifies the Field Office when an ETR request has been fully approved. EM-20 also has the responsibility for tracking and validating the closure of issues identified during an ETR.

## 1.2 INTEGRATED FACILITY DISPOSITION PROJECT

The Integrated Facility Disposition Project (IFDP) is designed to eliminate high risk legacies of the Manhattan Project and Cold War, complete environmental remediation, and enable ongoing modernization of the Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12) at the Oak Ridge Reservation (ORR). Many of the IFDP activities will be conducted under the Comprehensive Environmental Response Compensation, and Liability Act, compliant with the 1992 Federal Facility Agreement (FFA) between the U.S. Environmental Protection Agency (EPA), the Tennessee Department of Environment and Conservation (TDEC) and DOE. The DOE is the lead agency under the FFA. As such, DOE-EM is the DOE lead on the IFDP. However, the IFDP is also supported by the other resident program offices, specifically the DOE Office of Science (SC), DOE Office of Nuclear Energy (NE) and the DOE Office of National Nuclear Security Administration (NNSA) in a collaborative effort with DOE-EM.

The scope of the IFDP is broad, balancing environmental remediation, regulatory compliance issues, Deactivation and Decommissioning (D&D) activities, and disposition of legacy materials with ongoing modernization/reindustrialization initiatives at ORNL and Y-12. Specifically, the IFDP includes: 1) Demolition of 327 facilities at ORNL and 112 at Y-12; 2) Completion of remedial actions at 119 sites at ORNL and 118 sites at Y-12; 3) Reconfiguration activities at ORNL and Y-12 including road upgrades and construction of new treatment/storage facilities to support IFDP; and 4) Operation of existing and future waste treatment and disposal facilities.

The IFDP proposed duration is 26 – 32 years at a cost range of $5.15B to $7.97B, with the expectation the project will be completed in phases. The IFDP CD-0, Mission Need, was approved in July 2007. A Conceptual Design Report (CDR) and Preliminary Project Execution Plan (PPEP) for IFDP Critical Decision (CD)-1 have been submitted and are awaiting approval.

### 1.3 IFDP ETR REVIEW

DOE HQ EM-20 recommended an ETR be performed for the IFDP. DOE ORO agreed and, consistent with guidelines in the April 2008 ETR Process Guide and DOE-EM Standard Operating Policies and Procedures for ETRs, the scope, lines of inquiry and team composition for the ETR were developed based on project risk factors identified by ORO, and on the project's stage in the Acquisition Management System process defined by DOE O 413.3A (i.e. the CD-1 Approval stage). The ETR was scheduled to be conducted at an accelerated pace in order to support delivery of a draft report in August 2008. Initial scope, lines of inquiry, team composition and period of performance are outlined in the ETR Charter (Appendix A).

The scope of the ETR was defined based on the highest cost and risk factors for IFDP execution as identified by the DOE ORO: 1) Treatment and Disposal of large quantities of Mercury Contaminated Soil and Debris, and 2) the technical approach related to Facility Reconfiguration for radioactive waste and low level liquid waste (LLLW) management.

Following approval of the Charter, assembly of the ETR Team, and compilation of a comprehensive document package by ORO, the ETR was conducted as follows:

- May 27, 2008 – ETR Leads Initial visit to ORR
- June 6, 2008 – ETR Charter Issued

- June 16, 2008 – ETR Team Kick Off Conference Call
- June 20, 2008 – ETR Team Leads Meeting/Conference Call to discuss available reference documents, the agenda for a preliminary site visit to ORR, ETR scope, lines of inquiry and sub-team composition.
- June 24 – 25, 2008 – Preliminary site visit by ETR Team Leads.
- June 27 – July 11, 2008 – Sub-Teams initiate document reviews, initiate meetings/discussions and identify additional information needs.
- July 14 – July 22, 2008 – ETR Team site visit, Team reviews additional information, completes document reviews, participates in area specific site tours, assemble conclusions/recommendations, draft ETR report.
- July 22, 2008 – ETR Results Presented
- July 25, 2008 – Factual Accuracy Review Completed
- August 1, 2008 – Final Report Issued

### 1.3.1 TEAM STRUCTURE

Key criteria for the selection of the ETR Team are independence and expertise in technical areas relevant to the technical issues under review. The IFDP ETR Team consisted of experts in the areas of nuclear facility management, D&D, site remediation, waste management, chemical fate/transport in natural and engineered systems, and regulatory compliance. Team biographies are presented in Appendix D.

Due to the broad nature of the technical issues, and in order to meet the review schedule and maintain focus during the review, the ETR Team members were divided into three sub-teams: 1) "Leadership Team"; 2) "Mercury Team"; and 3) "Facilities Team". The specific sub-team members are as follows:

Leadership Team – Y. Collazo (ETR Lead), V. Adams (Deputy), A. Taboas (Technical Lead), J. Mathiesen (Document Manager)

Mercury Team – L. Katz (Lead), J. Clarke, A. Garrabrants, B. Looney, P. Maggiore, J.W. Porter, R. Provencher

Facilities Team – F. Parker (Lead), T.J. Abraham, R. Meehan, W. Schutte, D. Turner

The Leads, or their representative, for each sub-team would also participate on the Leadership Team. The sub-teams conducted their reviews independently. The entire ETR team met daily to discuss sub-team progress, preliminary issues and recommendations, report structure and progress, etc. Report development was coordinated and managed by the Leadership Team. The sub-teams drafted sections of the ETR Report addressing their respective technical area and provided them to the ETR Team document manager, who then compiled them into overall draft Report. The draft Report was reviewed by the Leadership team, and select members from each sub-team, to ensure uniform and accurate presentation of the sub-teams' conclusions and recommendations.

### 1.3.2 SCOPE OF REVIEW

As stated above, the overall review scope was developed based on the highest cost and risk factors identified for IFDP execution. The scope of the ETR was therefore focused on two large technical areas: 1) the remediation of large quantities of mercury-contaminated soil and debris; and 2) Facility Reconfiguration activities including the processing (characterization, treatment, packaging, and disposal) of radioactive waste streams for which no treatment capability and capacity exists on site.

The broad and complex nature of the technical areas required each sub-team to make a number of assumptions and identify a specific approach for their respective portion of the ETR, in order to maintain focus during the review. The Mercury Team assumed that the goals of mercury remediation in the IFDP focused predominantly on source reduction. In addition, it was assumed that the remedial actions of mercury-contaminated soil and debris fall principally within the scope of the Upper East Fork Poplar Creek Phase I and Phase II RODs. The Facilities Team focused especially on RH solids and LLLW at ORNL. The Facilities Team also looked at the replacement of aging and oversized infrastructure with centralized or building(s) specific facilities at ORNL, and replacement/relocation of some utilities in the present serial configuration or with building specific utilities at Y-12. Sub-team assumptions and review approach are described in the introductions for their respective sections of the ETR Report.

### 1.3.3 LINES OF INQUIRY

The IFDP ETR Charter included initial lines of inquiry for each of the two technical areas comprising the scope of the ETR. Following the preliminary site visit and initial document reviews, the sub-teams were given an opportunity to suggest modifications to the initial lines of inquiry. Suggested modifications were discussed with the entire ETR Team and incorporated as deemed appropriate. The lines of inquiry for the Facility Reconfiguration component of the ETR remained unchanged from those presented in the Charter. Minor modifications were made to the lines of inquiry for the Mercury-Contaminated Soil & Debris component of the ETR. These modified lines of inquiry are:

- Have the alternatives for characterization, treatment and disposition of mercury contaminated soil and debris, been appropriately evaluated and documented? Is the recommended alternative feasible and likely to be accepted by the regulators and stakeholders as meeting cleanup objectives?
- Have the alternatives for characterizing, fixing-in-place, or removing contaminated equipment and piping been appropriately evaluated and documented? Is the recommended alternative feasible and likely to be accepted by the regulators and stakeholders?
- Have the safety, security, technical, and programmatic risks associated with the recommended alternative been appropriately evaluated and documented?
- Are there additional alternative approaches/strategies that should be considered?

Established lines of inquiry were used by both sub-team to focus the scope of their respective reviews, and also served as a basis for the ETR Report format.

# 2.0 TREATMENT/DISPOSAL OF HG CONTAMINATED SOIL & DEBRIS

Mercury remediation presents a number of challenges due to mercury's physical-chemical properties, complex biogeochemical reactivity in the environment, and toxicity. As an inorganic contaminant, ultimate destruction is not possible and mercury may persist in aqueous and non-aqueous environments in a number of different forms for long periods of time. Large quantities of elemental mercury were used at the Y-12 plant between 1950 and 1963. Elemental mercury is a hydrophobic, volatile, dense non-aqueous phase liquid. Once released to the environment, elemental mercury can remain as elemental mercury or be transformed to mercuric and mercurous complexes or methyl mercury. Speciation of mercury in aqueous and terrestrial environments is governed by pH, oxidation/reduction potential, sulfide, halide and organic matter content and microbial and photochemical activity. Chemical speciation affects mobility, toxicity, and exposure routes.

The complex biogeochemistry presents numerous challenges for any remediation scenario. However, at Y-12 the large volume of contaminated waste, the site geology, shallow groundwater table, and proximity of surface waters to the contaminated buildings and soils present additional challenges for remediation. In addition, stringent emerging water quality goals and associated uncertainties may affect the remediation and present challenges for IFDP planning. Fortunately, significant progress has been made toward identifying remediation options and the interim RODs developed to date provide a foundation for technical and regulatory planning. These RODs form the basis for the design of future remediation within IFDP. In addition, IFDP will increase accessibility to contaminated soils and allow better access for more detailed site characterization.

Section 2.1 provides an assessment of the current conditions with respect to characterization of mercury contamination at Y-12 and the existing regulatory framework, and a description of the alternative evaluation process and the recommended alternative(s) for mercury remediation in CD-1. Section 2.2 presents the issues, recommendations and associated benefits identified during the ETR.

## 2.1 CURRENT CONDITIONS

The conditions discussed below were derived from information provided by ORO to the ETR Team. There were no independent field investigations or analyses conducted as part of this review.

### 2.1.1 NATURE AND EXTENT OF HG CONTAMINATION

Elemental mercury was used in the lithium separation process at the Y-12 complex between the years of 1950 and 1963. Analysis of historical and limited characterization information has indicated that an estimated 230,000 lbs of elemental mercury were lost from the West End Mercury Area (WEMA) during the period of lithium isotope separation activities, primarily before 1960. These losses have resulted in contamination of the facility infrastructure, surrounding soils and sediments, as well as discharges into Upper East Fork Poplar Creek (UEFPC), either directly via building drains and process discharges or indirectly through contaminant transport in the subsurface.

Figure 2-1 is a simplified site specific representation of mercury dynamics in the Y-12 UEFPC watershed. This figure identifies and highlights key local features (e.g., history, scale, heterogeneities, engineered features, etc.), and technical and environmental management issues, such as controlling biogeochemical processes and treatment opportunities.

#### 2.1.1.1 BUILDING SOURCES

Facilities within Y-12 where large quantities of mercury were handled include major process facilities (Alphas 2, 4, 5, and Beta 4), mercury receiving and recovery areas (Building 81-10, demolished in 1995), and several other support buildings. Mercury sources in the major process facilities include: 1) residual elemental mercury remaining in former process equipment; 2) mercury that collects in building dewatering sumps and flooded wind tunnels; or 3) seep from building components. The waste generated from D&D activities may include a combination of low-level waste, hazardous waste, mixed waste and uncontaminated debris.

The D&D of the three Alpha and one Beta buildings is estimated to produce approximately 397,000 $yd^3$ of debris. The CD-1 documentation presents cases estimating amounts of mercury-contaminated debris for treatment ranging from 126,000 to 217,000 $yd^3$ with a most likely case of 159,000 $yd^3$ (PPEP Attachment I, Appendix D). These estimates assume that 100% of the construction debris from Alpha 4 and 20-30% of the construction debris from the other major process facilities is mercury-contaminated.

Storm drains, which historically had diverted ground water from basement dewatering sumps to UEFPC, continue to be a source of elemental mercury to the surface waters. Under the Phase I ROD, approximately 11,500 linear feet of storm drain will be flushed at high pressure and approximately 2,650 linear feet of storm sewer will be relined or replaced.

#### 2.1.1.2 CONTAMINATED SOILS

Figure 2-2 identifies areas of mercury contamination in surface soils across the Y-12 complex in relation to mercury use areas. Concentrations of mercury in surface soils are greatest in the western portion of Y-12, with historical concentrations as high as 7,700 mg/kg within the WEMA. The majority of mercury concentrations in contaminated areas of the complex range between 1 and 100 mg/kg. The amount and location of residual mercury retained in soils beneath basements and in storm sewers at Y-12 is currently uncertain. The CD-1 documentation estimates that approximately 82,500 $yd^3$ of contaminated soils from baseline RA and D&D actions will require pre-treatment for disposal. The speciation of mercury in these soils is likely to include both elemental and oxidized forms of mercury.

#### 2.1.1.3 GROUND AND SURFACE WATERS

Mercury contamination of surface waters of UEFPC is the result of commingling of releases from multiple sources including storm drain outflows and non-point sources (e.g., runoff from contaminated soils) and groundwater flux. The major process facilities, as well as associated process and storm piping, act as the principal sources of mercury to UEFPC with lesser contributions coming from operations within the other mercury-contaminated areas. The presence of mercury in surface waters, channel sediments and fish tissue has been documented which indicates that mercury speciation includes both inorganic and methyl mercury. Storm drain and ground water outflow to UEFPC is augmented by water diverted from the Clinch River at a rate of approximately 4.5 million gallons a day. The inflow of augmentation water is suspected to increase mercury transport downstream and provides oxygenation of the UEFPC surface water. The addition of sulfite to this augmented water as a dechlorination agent may be impacting the rate of mercury methylation.

Various activities have been performed to reduce mercury releases and impacts in the vicinity of Y-12 including process modifications, removal/excavation and physical isolation (e.g., “bank stabilization”) of contaminated soil and sediment, water treatment, lining or replacement of mercury contaminated underground lines, flow management, pond replacement and bypass, facility decommissioning, and other activities. Since 1989, average total mercury concentrations at Station 17 has been reduced approximately fourfold from around 1.6 µg/L to 0.4 µg/L, while concentration in the fish tissue remained relatively stable at approximately 0.8 mg/kg. The applicable Tennessee water quality criterion is 0.051 µg/L. Follow up research has documented the importance of mercury speciation to the observed concentrations in fish tissue with fish tissue concentration related to methyl mercury rather than total mercury. The differences in the trends in time and space in stream concentrations are ultimately explained in terms of complex, inter-related and interacting transport and transformation processes. Furthermore, concentrations of mercury in UEFPC fluctuate with storm events which produce runoff from/through contaminated areas and increase turbulence of flow in the stream channel and storm drains.

#### 2.1.1.4 CONTAMINANT TRANSPORT PATHWAYS

Figure 2-3 shows a conceptual model of the subsurface structure and contaminant release pathways within the UEFPC area. The subsurface beneath the Y-12 complex consists of a layer of unconsolidated clays and silts overlying bedrock in the form of shale and limestone. The thickness of the unconsolidated material varies from a few feet to nearly 30-ft in the north-central area of the complex. In the near and underlying UEFPC, the bedrock is primarily Maynardville Limestone, a karst formation noted for relatively high permeability via flow through fractures. The ground water level ranges from less than 10 feet below the surface at the south end of the complex to more than 30 feet below the surface at the northern portion. Infiltrating water transports horizontally in overlying soils or percolates vertically through to the karst systems where it becomes available to feed surface water.

Building sumps pull in ground water from the immediate area surrounding process buildings. These sumps historically fed ground water into the storm drain system, but have been rerouted to water treatment facilities. Alpha 5 sumps are no longer in operation resulting in water accumulation in the building wind tunnels. Release mechanisms to groundwater include historical spills, leaks and dissolution from contaminated soils and sediments.

The Phase I ROD cites mercury concentrations of 1,000 mg/kg at a depth of 12 feet in the area of the demolished Building 81-10. Due in part to the non-wetting properties and high density of liquid mercury, spills and leaks of mercury at the surface or within buildings may result in deposits of subsurface liquid mercury in both the unconsolidated and bedrock intervals. These deposits may provide a long-term source of mercury contamination in the ground water which feeds the UEFPC as evidenced by the presence of mercury from Outfall 51 which drains a large spring adjacent to Alpha 2.

### 2.1.2 REGULATORY STATUS

The Oak Ridge Reservation (ORR) is part of a "tri-party" group; including DOE, EPA and the State of Tennessee, which has executed a Federal Facility Agreement (FFA). This FFA provides a framework for conducting remediation activities at the ORR, including prescribed timeframes for various activities. One key activity under the FFA was the conduct of investigations under CERCLA leading to Records of Decision (RODs) including: 1) a Phase I ROD for Interim Source Control in the Upper East Fork of Poplar Creek (UEFPC); and 2) a Phase II ROD for Interim Remedial Actions for Contaminated Soils and Scrapyards in the UEFPC.

The primary work elements for the Phase I and Phase II RODs are summarized in Figure 2-4 with respect to the Integrated Facilities Disposition Project (IFDP). The key parts of the IFDP which relate to mercury contamination are:

- Remedial actions of the UEFPC
- D&D of Alpha & Beta Buildings

The first item above is governed by the Phase I & Phase II RODs, while the D&D of the Alpha and Beta Buildings are not. However, once building slabs are removed and impacted soils become accessible, they are covered within the scope of the Phase II ROD. One key performance parameter for the CERCLA RODs includes 0.2 µg/L of mercury discharged, as well as various NPDES limitations. Pursuant to Section 303(d) of the Clean Water Act (CWA), TDEC has informed DOE that a Total Maximum Daily Load (TMDL) for mercury in the East Fork Poplar Creek (EFPC) will be established based on the fish tissue standard of 0.3 mg/kg. It is unclear how the fish tissue standard will be converted to a water quality standard, but it is likely that the resulting standard will become an applicable and relevant or appropriate requirement (ARAR), and it will drive further mercury remediation in the EFPC watershed. RCRA Land Disposal Restrictions (LDRs) will also be an ARAR with respect to waste sent to the EMWMF.

### 2.1.3 IFDP MERCURY REMEDIATION

The potential IFDP alternatives to address mercury contaminated soil and debris at Y-12 need to encompass all aspects of the problem including identifying contaminated materials and then removing, handling, treating, and dispositioning those materials. These steps are depicted schematically in Figure 2-5. A crucial aspect of the alternatives evaluation process is assessing the strengths and weaknesses of the various possible technologies and matching potentially viable technologies to site-specific conditions including the forms, distribution, chemistry, and accessibility of wastes, as well as IFDP goals and objectives. The review team believes that some of the key mercury related objectives for the IFDP are to implement the activities necessary to meet the CERCLA regulatory commitments under the two existing RODs. These fundamental commitments serve as a starting baseline for the IFDP and actions to meet them were already included in an EM baseline prior to IFDP project planning. The existing EM Baseline, which has been under configuration control since 1997 and which was validated by the Office of Engineering and Construction Management (OECM) in 2007, includes remedial actions and D&D activities at ORNL and Y-12. Although progress has been made through previous CERCLA actions, today's EM life-cycle baseline only accounts for a fraction of the cleanup scope that exists at ORNL and Y-12. The IFDP represents an integration process that expands the baseline to more thoroughly address source area mercury at Y-12 in the UEFPC watershed.

There are significant advantages to the IFDP approach. Most important is taking advantage of the synergy between facility D&D and access to previously inaccessible contaminated soil and debris. The concept encourages collaboration among the various DOE organizations and encourages an integrated and comprehensive approach to reducing the impacts of mercury from Oak Ridge on the surrounding environment. The proposed IFDP mercury activities eliminate some of the legacy mercury source challenges at Y-12 and support development of future missions in safe-clean facilities. There are also potential negatives associated with the IFDP. Notably, the IFDP has the potential to expose contaminated environments and care will be needed to avoid increasing the releases of mercury in the short or medium term. For example, care will be needed to avoid occupational inhalation exposure to mercury onsite; conversely, the use of large volumes of water for dust control rather than misting systems might serve as a driving force to accelerate subsurface mercury migration to UEFPC. These negatives could be particularly important if the design and implementation is not carefully performed.

### 2.1.4 APPROACH FOR ALTERNATIVES EVALUATION

A significant challenge in the development of the IFDP was that some of the goals in the CD-1 documentation overreached the potential performance of an effort that focuses only on remediation of mercury contaminated buildings and shallow soil (the CD-1 executive summary asserts that a benefit will be "mercury remediation complete"). Such goals contrast with a central IFDP precept of integration and imply that IFDP alone will address the entire mercury problem. The IFDP alternatives evaluation needs to recognize that addressing mercury at Y-12 will require a broader systems engineering approach and collaboration within a clear process for comprehensive management of mercury contamination in the Y12 UEFPC watershed. The IFDP goals need to clearly articulate the specific role of the IFDP in mitigating the impacts of Oak Ridge related mercury on the surrounding environment and highlight the need for continuing the related and enabling efforts that are underway at the site (water diversion, stream rerouting, technologies that decrease methylation or increase demethylation), etc. A key assumption made by the review team was that the goals of the mercury remediation in IFDP focus predominantly on source reduction.

The approach taken for the alternatives evaluation in the IFDP was to use the EM baseline as a starting point and then to upscale or expand the activities based on a variety of assumptions (e.g., increased waste quantities). While this is generally reasonable for purposes of a conceptual design to support CD-1, the approach did not result in a clear and defensible technology selection process. In particular, IFDP technology selection and design would benefit from more effective use of available technical and regulatory resources such as the EPA (2007) report, *Treatment Technologies for Mercury in Soil, Waste, and Water*. This report identified and described mercury treatment options for soil and debris including selection criteria to help match technologies to site-specific conditions, evaluations of past demonstration tests and historical cost experiences. As depicted in Figure 2-5, the EPA (2007) report evaluated mercury technologies in broad categories (solidification/stabilization versus extraction/removal). The report provided a clear description of each category and then evaluated specific technologies and options. Figure 2-6 provides an example synopsis of the type of information provided by EPA to assist in matching mercury technologies to site objectives and conditions. In general, in situ and ex situ options were addressed in the evaluations and information was provided on emerging technologies. As described in Section 2.2, the reviewers believe that a clear, step-by-step process with supporting data and assumptions will be critical to project success as the effort moves from the conceptual design to future critical decisions (CD-2/3). Part of this effort will include confirming the technology selection and may include EM technical assistance and further support by independent technical experts.

As noted by the dashed boundary on Figure 2-5, the CD-1 documentation focused on alternatives for treatment of mercury contaminated soil and debris. Alternative strategies for properly creating those stacks of contaminated soil and debris, while crucial to success and primary tools for controlling costs, were not included in the CD-1 alternatives review. Indeed, the topics of waste characterization, handling and segregation were not discussed – the evaluation started with tabulated amounts of soil or debris that were assumed to be mercury contaminated.

The IFDP provides conceptual alternatives evaluation/selection within several major categories, including D&D, remedial actions, and waste disposal. The typical approach for the alternatives selection for each of these categories was to identify three alternatives, “alternative a”, “alternative b”, and “case by case combination of alternatives a & b as appropriate.” In the documentation, each of the alternatives was described in a summary fashion, but the actual technology portfolio that comprised the alternatives was not specifically identified in the summary material (it can be determined only by looking through various spreadsheets and contingency forms). A “case-by-case” matching of the technical solution to the specific problem is an acceptable approach as long as the project design and support documentation provides the basis for the process.

Importantly, the issues related to mercury contaminated soil and debris cross-cut these IFDP categories. As an example, for mercury related remedial actions, the alternatives evaluated included: a) In-situ stabilization, source removal, capping, and isolation; b) Excavation/removal … {maximum} 2-ft in the western portion of Y-12, and 10-ft or bedrock in the eastern portion of Y-12; and c) Case-by-Case application of *in situ* stabilization capping, isolation, and excavation/ removal. Similarly, for waste disposition, the alternatives were off-site, on-site, or case-by-case disposition as appropriate. Unfortunately, the technologies incorporated into the implementation of the recommended alternative(s) did not clearly align with the selected alternative(s). *In situ* technologies for remedial actions were not significantly described or incorporated, for example.

A positive feature of the recommended alternative is its relative simplicity, see Figure 2-7. The waste quantities depicted on this figure are the IFDP assumed "most likely case" – assumptions for best case and worst case values were also developed in the IFDP as bounding values. The forecasted mercury contaminated soil and debris is to be treated by either low temperature thermal desorption (LTTD) or by macroencapsulation and disposed on-site if possible. Details of the recommended alternative along with key uncertainties and bounding topics will be addressed in more detail in 2.1.5.

### 2.1.5 CURRENT CD-1 RECOMMENDED ALTERNATIVE(S)

In the sections that follow, information is provided concerning the CD-1 recommended alternative. Remedial actions and treatment and disposal options are identified. A listing of the performance criteria that were used in the selection process for the recommended alternative is provided.

#### 2.1.5.1 DESCRIPTION OF THE RECOMMENDED ALTERNATIVE

The recommended alternative is a case-by-case application of in-situ stabilization and excavation/removal with a combination of onsite and offsite waste disposal. On-site disposal will utilize the existing EMWMF together with a proposed new disposal facility that will contain a subcell dedicated to the disposal of Hg-contaminated materials debris. Off-site disposal is expected to utilize an appropriately permitted facility such as the Nevada Test Site. The majority of the debris from remedial actions and D&D will be encapsulated and pre-treated as needed using low temperature thermal desorption. Contaminated soils and a fraction of the debris from Alpha 4 are assumed to be treated by low temperature thermal desorption. IFDP planning assumptions reflect the baseline assumptions provided in the interim RODs (See Figure 2-7).

#### 2.1.5.2 BASIS FOR SELECTION OF THE RECOMMENDED ALTERNATIVE

The CD-1 document did not provide a specific discussion of the process that was followed to evaluate the identified alternatives and select the recommended alternative. The baseline assumptions in the RODs were used as foundation upon which additional estimates were made.

A document was developed at the request of the review team by Pro2Serve staff entitled "DRAFT Mercury Ttreatment/Management Options within the IFDP". According to this document, the evaluation of Hg related D&D and remedial activities considered the following performance criteria:

- species of Hg present at the site(s)
- characterization data available
- characterization needs
- onsite vs. offsite treatment options application of low temperature thermal desorption
- solidification/macroencapsulation
- amalgamation
- onsite disposition, dedicated cell development vs. offsite disposition
- potential regulatory and stakeholder issues, LDR issues and potential variances to LDR requirements
- status in existing baseline

This document served as the basis for the review team's evaluation of the selection of the recommended alternative.

## 2.2 CD-1 EVALUATION PER LINES OF INQUIRY

The major finding of the review team was that the approach to mercury remediation outlined in the CD-1 IFDP document is technically valid for a CD-1 level of effort. Many of the mercury-related issues and recommendations are consistent with the "cross-cutting ideas for increased effectiveness" developed by the Energy Technology and Business Association at their IFDP workshop (ETEBA, 2008). The review team emphasized the need for mercury remediation at Y-12 and concluded that DOE would benefit by initiating and completing the important IFDP mercury remediation activities as rapidly as possible especially with respect to completing the RODs under CERCLA. The main concerns identified in the review relate to the amount of uncertainty as to the treatment/disposal options and quantities of debris and soil to be treated and/or disposed and these need to be reflected in both the design assumptions and the cost and scheduling risk estimates. It was concluded that these uncertainties should be adequately bounded by the potential range of outcomes during CD2/3. The review team supports the IFDP process and believes that the IFDP is an important component, but only part, of the comprehensive efforts that will be needed to mitigate the impacts of Oak Ridge related mercury on the surrounding environment.

Three overarching issues were identified for IFDP activities associated with mercury remediation at the Y-12 site. These issues have ramifications with respect to the selection of alternative mercury remediation strategies, the technical feasibility of the selected process, the assessment of project effectiveness, and the programmatic, safety and security risks. These three overarching issues and accompanying recommendations are:

**Issue 2-1: IFDP integrates the efforts of multiple DOE organizations and landlords to achieve significant progress on the shared goal of remediating mercury at Y-12.** The ORR IFDP at Y-12 is being performed in an area with a patchwork of surface and facility DOE landlords (NE, SC, NNSA and EM). Contaminated soil and groundwater underlie this surface ownership milieu. EM has organizational authorities to implement remedial activities on the contaminated soil and groundwater. The IFDP represents a unique collaboration of these four DOE offices and attempts to minimize inter-office bureaucratic complexities while optimizing cooperation, clear lines of authority, and ease of project implementation.

**Recommendation 2-1**: Continue this desirable practice. The IFDP project appears to be a relatively unique approach for such a complex undertaking. By agreeing to collaborate up-front the various DOE offices have both individually and as a group greatly enhanced the potential for project success. (Good Practices)

**Issue 2-2: The benefits and objectives for the mercury remediation activities within the IFDP documentation lack specificity and clarity.** The broad-overarching benefits and objectives for the IFDP are laudable – reducing risks, reducing costs, facilitating effective facility modernization, maintaining a skilled workforce, continuing revitalization momentum, etc. However, CD-1 contains statements that refer to different endpoints for mercury remediation in IFDP including mercury source reduction to provide protection of the workforce during and after facility modernization, completion of mercury remediation and water quality improvement. The CD-1 document does not provide a strategy for developing a comprehensive plan to achieve all of these objectives within IFDP. Statements such as "Improve water quality of East Fork Poplar Creek" are ambiguous and "Mercury remediation {will be} complete" are possibly unattainable in the context of IFDP. Moreover, the mercury remediation goals in the IFDP do not demonstrate a clear awareness and linkage to the diverse mercury remediation and environmental management efforts at Oak Ridge.

**Recommendation 2-2**: Clear, measurable and achievable goals for IFDP mercury remediation should be developed to support the design activities in CD2/3 and to support future remediation. (Technical Issue; Opportunity for Improvement)

**Issue 2-3: IFDP actions alone will not "get rid of environmental liabilities" as stated in the CD-1 documentation.** When released to the environment, elemental mercury behaves as a dense non-aqueous phase liquid (DNAPL). Elemental mercury penetration below the shallow soil and pooling in the underlying karst system are probable hot spots where large volumes were released, areas with preferential flow paths, and areas where releases were below the water table (e.g., from building basements and sumps). Residual elemental mercury has also been documented in effluent discharge systems and in Upper East Fork Poplar Creek sediments. These mercury sources are not addressed by IFDP actions. Previous evaluations (Looney et al. 2008) describe a conceptual model of mercury release from Y12 and the controlling mercury geochemistry, as well as the challenges associated with mercury remediation at this site. A key conclusion of the earlier review effort, that this team supports, was that there is not a direct linkage between mercury source reduction and emerging stream protection endpoints such as fish tissue concentrations. However, mercury source reduction is a key component of the two primary regulatory drivers currently addressing mercury remediation.

**Recommendation 2-3**: Consistent with earlier review teams (Looney et al., 2008), ORR should work with their regulators and stakeholders to develop a realistic environmental management strategy and associated regulatory permits/commitments that reduce mercury impacts to levels that are as low as reasonably achievable. Critical first steps toward this effort are to move ahead expeditiously with the CERCLA mandated work as well as to integrate IFDP and other source mitigation activities with other actions to maximize environmental benefit and regulatory responsiveness, and minimize costs, energy use and adverse collateral impacts. (Technical Issue; Opportunity for Improvement)

**Benefits of Implementing Recommendations 2-1, 2-2, and 2-3**

Integration of efforts from multiple DOE organizations and landlords toward a single unified goal should facilitate timely completion of the IFDP and serve as a model for future DOE efforts at other sites. Formulation of clear remediation goals will ensure that design activities address realistic and identifiable metrics for mercury contamination cleanup. As completion of existing CERCLA-mandated work and accompanying building D&D activities move forward future problem areas and regulatory regimes will come into sharper focus.

### 2.2.1 OVERALL COMPLETENESS OF ALTERNATIVES EVALUATION

The ETR identified a number of issues and recommendations for consideration as the IFDP process moves into more detailed design, engineering and project management.

**Issue 2-4: The current conceptual design presented in CD-1 provides little information and focus on the process and pathway to implement the selected case-by-case alternative for remediation of mercury contaminated soil and debris.** The text of the selected alternative for remediation of mercury contaminated soil and debris is "case-by-case application of in-situ stabilization, capping and isolation, and excavation/removal." This is a sensible and appropriate alternative and this need-specific technology portfolio approach is supported by the review team. A key responsibility associated with selecting this type of alternative is to describe the process by which the technology matching and case-by-case decisions will be made. Even at this early stage of project development, a conceptual description is needed so that the planned metrics and technologies associated with the decision path are defined – thus supporting a better contingency evaluation and facilitating future design efforts. For example, there is little discussion in the IFDP related to technical evaluation of in situ stabilization technologies and capping. Instead, emphasis is placed on cost. Furthermore, use of macroencapsulation as a treatment methodology for low level mercury contaminated debris would likely require performance-based support in the form of binder recipe development and pilot-scale tests. A study (Sanchez et al, 2001) on treatment technologies for mercury-contaminated mixed wastes from Brookhaven National Lab and Oak Ridge Reservation showed that solidification/stabilization recipes, designed to pass TCLP, may result in unacceptable mercury release when the treated material is placed in a landfill where conditions differ from regulatory test conditions. Thus, demonstration of macroencapsulation prior to case-by-case selection of alternatives may be necessary for inclusion of the process in the case-by-case portfolio and prior to regulatory acceptance.

**Recommendation 2-4**: Metrics related to "how" decisions will be made during implementation of a case-by-case application of technologies should be developed to support the design activities in CD2/3 and to support implementation and field activities. Consider developing a governing flowchart that utilizes resources such as the EPA report, *Treatment Technologies for Mercury in Soil, Water and Waste*, so that the technical basis and defensibility of the technology selection/design and waste characterization/segregation processes are clear. It would also be advisable to conduct a joint internal/external technical design review of potentially viable in-situ and ex-situ treatment options during CD-2/3 to ensure that all potential treatment options have been considered for each case in the case-by-case evaluation. Finally, the approach should not only be need-specific but adaptive. (Technical Issue)

**Issue 2-5: The basis for the assumed quantities of contaminated versus uncontaminated debris needs to be documented and clarified.** For example, the estimate for the quantity of mercury contaminated debris in Alpha 4 increased from approximately 4,500 CY (7% of the Alpha 4 debris) in the EM Baseline to 66,000 CY (100% of the Alpha 4 debris) in the IFDP CD-1 project contingency. In the EM Baseline, the quantity of contaminated debris was estimated to range from 1,000 to 20,000 CY in going from the best case to worst case scenario as indicated in EM Risk Assessment Form 81. In the IFDP CD-1, the assumed 66,000 CY from Alpha 4 is applied to all scenarios (best case, most likely case and worst case) in the Risk Information Form 0004 and represents over 40% of the mercury contaminated debris in the "most likely" scenario. The basis for this large increase was not justified within the document but appears to have been based on discussions with Y-12 engineering personnel and limited characterization data from a 1994 planning document (Martin Marietta Energy Systems, Inc., 1994). However, building samples from Alpha 4 reported in Radian (1995) indicated that much of the debris from the building is below the "level of concern for removal." The large differences in assumed quantities of contaminated debris have impacts on scheduling, cost estimates and technical design of the project.

**Recommendation 2-5**: More accurate estimates of and the basis for assumptions regarding the quantities of mercury contaminated debris, equipment and piping are required to support CD 2/3 technical feasibility, cost and scheduling estimates. (Technical Issue)

**Issue 2-6: The metrics and technologies for characterizing and segregating mercury contaminated soil and debris from uncontaminated soil and debris during IFDP activities were not provided nor referenced in the IFDP documentation.** Identifying rapid, cost-effective, and defensible metrics technology for waste characterization and segregation is crucial to project success because these technologies impact schedule, waste throughput, and the total quantity of waste that requires costly pretreatment prior to disposal.

**Recommendation 2-6**: To support the CD-2/3 design and future IFDP activities, the IFDP needs to clarify, document and implement technically-based methods to characterize and segregate contaminated soil and debris. (Technical Issue)

**Benefits of Implementing Recommendations 2-4, 2-5 & 2-6**

Developing and clearly documenting the processes and data used to develop the selected case by case alternative is an important effort that will strengthen the IFDP program as CD-2/3 are developed. This "process" documentation will provide confidence in the technical basis for the match of selected treatment methods to the characteristics of the soil and debris, for projecting the scale of the treatment and disposal needs, and for metrics and methods of characterization and segregation of uncontaminated versus contaminated wastes.

### 2.2.2 TECHNICAL FEASIBILITY AND EFFECTIVENESS

In principle, the remedial approaches that are described in the recommended alternative are demonstrated and proven for known and established waste-specific and environmental site-specific conditions. Uncertainties remain, however, that will require further characterization data to evaluate. In particular, the amounts of mercury-contaminated soils beneath buildings targeted for demolition are unknown. Also, as pointed out in Section 2.1.4, the distribution of volumes targeted for onsite and offsite disposal could change as well as the volume of material that will require pretreatment with low temperature thermal desorption.

**Issue 2-7: Regardless of the screening criteria for pretreatment of soils, there is insufficient data for allocating the soils requiring treatment.** Actual data collected during field activities could result in substantial changes to the projected quantities of "accessible unacceptably contaminated soils exceeding the remediation level for protection of groundwater and surface water." These quantities control the magnitude of mercury treatment and subsequent waste disposal. Based on the CD-1 documentation, the estimates of soil volumes were based on rough guides of expected removal depth, anticipated areas of soil contaminated and expected mercury concentrations. These criteria and the evaluation were not supported in the CD-1 by data and documentation. The existing CERCLA RODs for Y-12 are being used as a planning basis for the IFDP. These RODs provide graded commitments for removal of soil contaminated by mercury including specific target excavation depths (2 feet or 10 feet) depending on potential future land use. These commitments also describe the need for excavation of mercury contaminated soil to the designated depth, water table and/or to bedrock (depending on the specific local conditions). Building demolition most likely will expose currently undocumented residual mercury (e.g. below Alpha-4) and subsurface investigations of areas that had been inaccessible below buildings may reveal Hg at depth with a potential corresponding impact on volume and pretreatment assumptions.

**Recommendation 2-7:** During the CD-2/3 project design activities, improve estimates of quantities of mercury contaminated soil requiring treatment. The review team recommends expedited collection of sub-slab characterization data (e.g., using techniques such as field screening, horizontal borings, sub-slab penetrations, etc.) and other supplementary characterization as required in the near term. This would result in data that would allow refinement of waste volume forecasts, adding certainty to waste dispositioning projections. Further, engineers and scientists working on CD-2/3 should consider identification, development and incorporation of technically acceptable field methods for soil and debris to support efficient and effective IFDP execution. These methods might include onsite screening instrumentation and in situ monitoring methods (e.g., membrane interface probe). (Opportunity for Improvement)

**Issue 2-8: The approaches used for assessing the need for and adequacy of treatment may not mimic field conditions.** The CD-1 report and the RODs state that basis for the decision of pretreatment will be the LDR provisions. Under the LDR, decisions on the need for pretreatment of mercury-contaminated wastes are based on total mercury content (i.e., materials with total mercury content >260 mg/kg require treatment). This total mercury approach does not consider the speciation of the mercury in the soil or debris nor has it been proven to be an indicator of leaching characteristics or environmental risk. Following treatment, acceptance criteria for disposal in the EMWMF are dependent on the results of the Toxicity Characteristic Leaching Procedure (TCLP). However, the applicability of TCLP for highly alkaline materials (e.g., cement binders typically used in encapsulation technologies) has been noted as "inadequate" for determining long-term leaching performance by the Science Advisory Board for the USEPA (USEPA, 1991; USEPA 1999). In addition, the conditions of TCLP do not reflect the release conditions of disposal in the EMWMF.

**Recommendation 2-8:** The DOE should consider entering into discussions with the EPA on use and approval of an alternative, performance-based approach for the purposes of characterization of mercury-contaminated debris, treatment development and effectiveness documentation, support of disposal scenario performance assessment. One such leaching characterization approach (Kosson et al, 2002) that could be applied to mercury-contaminated soils and construction debris is under consideration by the USEPA Office of Solid Waste for adoption into SW-846. This approach has been demonstrated for pre-disposal treatment of DOE mercury-contaminated mixed wastes (Sanchez et al, 2001; Sanchez et al, 2002). This approach would provide a rigorous and more relevant assessment of leaching potentials and rates of release from mercury-contaminated soils and debris and has the potential to decrease the fraction of IFDP materials requiring treatment. (Technical Issue)

**Issue 2-9: There is no substantive plan for addressing recycling in the CD-1 document.** The review team was informed that recycling of uncontaminated high value material from radioactive processing and handling facilities is permitted for nuclear applications but that there is currently a moratorium on the unrestricted release of such recyclable materials into commerce. There is a significant amount of potentially recyclable material in Alpha 4, a facility for which 100% of the debris is assumed to be mercury-contaminated under all assumed contingencies, as well as in several of the other buildings slated for D&D under IFDP.

**Recommendation 2-9:** The review team recommends that recycling opportunities, both within the DOE complex and in commerce, be considered as appropriate. Recycling of valuable materials generated through IFDP activities would add to the overall environmental benefits from the IFDP and conserve financial and physical resources. (Opportunity for Improvement)

**Issue 2-10: The IFDP base case for a portion (7%) of the mercury-contaminated debris from Alpha 4 assumes treatment by LTTD (consistent with CERCLA ROD assumptions).** The EM Baseline estimate for the amount of mercury contaminated debris from D&D of Alpha 4 was 4,500 $yd^3$ (with a bounding range of 1,000 to 20,000 $yd^3$). This is approximately 7% (bounding range of 2 to 30%) of the total Alpha 4 debris (66,000 $yd^3$). The EM baseline is based primarily on the CERCLA ROD in which LTTD was identified as the treatment for Alpha 4 mercury contaminated debris. The IFDP greatly expands the total quantity of total D&D debris by increasing the number of facilities slated for D&D and by increasing the assumption of required treatment for Alpha 4 debris to 100% in the project contingency. Further, the IFDP has identified an alternative technology for treatment and disposition of D&D debris that is significantly less costly. Nonetheless, a volume of 4,500 $yd^3$ of Alpha 4 debris with a specific ROD assumption for LTTD is assigned to that treatment mode in the IFDP. If the performance of the alternative technology is confirmed, it would be prudent to shift the treatment of all Alpha 4 debris to the alternative process and work with regulators and stakeholders toward that end.

**Recommendation 2-10**: Integrate the disposition of this portion of the Alpha 4 mercury-contaminated debris with other similar debris (e.g., Alpha 2, bulk of Alpha 4, Alpha 5 and Beta 4) in order to eliminate the need for a separate and costly debris handling/preparation operation for LTTD and accommodate the Alpha 4 debris in an alternative existing IFDP process (macroencapsulation). This action would provide a higher degree of environmental protection as well as make the debris handling consistent across the program. (Opportunity for Improvement)

**Benefits of Implementing Recommendations 2-7, 2-8, 2-9 & 2-10**

Adoption of the recommendations provided above will strengthen the IDFP in several ways. The technologies proposed for soil and debris treatment are technically viable yet uncertainties remain. Adoption of a metric such as an appropriate and relevant leaching test methodology will enable a defensible quantitative determination of the disposition of mercury contaminated soils. Revisiting estimation of the offsite disposal risks will build confidence in the estimates of volumes and associated waste disposition pathways and may suggest modifications to current plans for on-site disposal. Incorporation of an evaluation of potential recycling opportunities could result in conservation of valuable financial and materials resources.

Clarification of the intent of current RODs with respect to reducing sources of mercury contamination is needed since the actions outlined in the CD will not fully address water quality issues resulting from legacy mercury sources. These issues would require future actions to achieve more stringent water quality standards. Further technologies are needed to create and meet final RODs to address these issues.

### 2.2.3 REGULATORY & STAKEHOLDER ACCEPTANCE

The IFDP project has the benefit of being proposed with a robust and mature regulatory framework. Notwithstanding the complexity of some of the technical issues associated with surface / groundwater interactions, the treatment and disposal of mercury-contaminated soil and debris, and meeting the terms and conditions of the to-be-issued NPDES permit pursuant to the CWA, the proposed IFDP regulatory strategy appears to be comprehensive, robust, and contains a high probability for success.

**Issue 2-11: Delay with respect to the implementation of CERCLA remedial actions could result in the IFDP project to be impacted by additional project risk.** By working proactively and collaboratively with all regulatory stakeholders to fully implement the CERCLA remedial action provisions, DOE will more rapidly achieve cleanup goals. Actions and documented progress in meeting mercury related commitments under CERCLA would demonstrate DOE's efforts to advance environmental protection and strengthen DOE's position in negotiating future mercury limits (e.g., TMDLs) and permits (e.g., NPDES).

**Recommendation 2-11:** In order to stay on the CERCLA track, it is important to proceed with commitments for remedial action in a disciplined but expeditious manner. Completing CERCLA activities in the short term (for example, expeditiously implementing building D&D) could have two benefits: (1) demonstration of progress with respect to moving ahead with CERCLA and, (2) allowance for evaluation of the actual extent and magnitude of mercury contamination beneath these structures.

**Issue 2-12: The extended time frame for finalization of the remaining RODs causes unnecessary uncertainty in the implementation of the remedial actions.** For example, the two existing RODs are interim in status and the groundwater ROD is currently scheduled for completion in 2035.

**Recommendation 2-12**: Accelerate the schedule for finalizing the remaining RODs. By moving these dates forward, the IFDP project could benefit by having better clarity and certainty in addressing future groundwater issues which will undoubtedly arise. The team is not suggesting bringing these RODs in before source control measures are implemented. Rather, beginning a process of defining the long-term remediation goals and having these goals reflected in final RODs sooner than what is currently scheduled will allow for integration of these efforts into a more holistic approach to mercury remediation across the watershed. (Technical Issue)

**Issue 2-13: The location of ultimate IFDP soil and debris disposition remains uncertain until more detailed soil and debris characterization and more accurate waste volume estimates are available.** Currently, 10% of the total contaminated material is assumed as the most likely estimate of the volume of waste that will need to be taken to an offsite facility due to regulatory restrictions. The remainder is slated for onsite disposal. Construction of a new on-site disposal facility with a subcell dedicated to mercury contaminated materials is a critical component of the IFDP given the limited capacity of the existing EMWMF. The waste acceptance criteria for the proposed onsite IFDP disposal options are not finalized, nor are the potentialities for wastes containing unacceptable levels of radionuclides or other factors that might limit waste acceptability. The Nevada Test Site (NTS) is the primary offsite disposal facility identified in the IFDP documentation and NTS is scheduled to be closed for mixed, low-level waste by December 2010 – before the new on-site facility is estimated to be available. Finally, the performance or adequacy of selected key technologies have not been demonstrated for the Y-12 debris waste. These key technologies include macroencapsulation and the proposed macroencapsulation application scenario in the mercury disposal cell (e.g., bulk mecroencapsulation versus boxed macroencapsulation). These uncertainties are significant since they may control the regulatory acceptance of the proposed onsite facility for disposal of mercury contaminated debris. If this CD-1 assumed facility is not approved, offsite waste disposal volumes may increase.

**Recommendation 2-13a**: The ERT recommends additional evaluation of potential waste characteristics when developing CD-2/3. This would provide data and a technical basis to confirm or refine selected technologies for Y-12 mercury contaminated debris and waste dispositioning projections. (Technical Issue)

**Recommendation 2-13b:** The ERT recommends that the new disposal cell be designed and operated to provide a high degree of environmental protection and development of waste acceptance criteria that focus on maximizing the portion of the IFDP waste acceptable for safe on-site disposition. (Technical Issue)

**Issue 2-14: Overlap of NPDES with CERCLA remedial actions could present challenges or opportunities.** The recent decision of having EM and NNSA be co-permittees for the NPDES is viewed as a positive step. The to-be-issued NPDES permit may result in effluent discharge limitations which will be challenging to meet. The potential for having multiple and conflicting permit terms and conditions could be addressed by the Core Team process. This new permitting framework will involve both the TDEC NPDES regulators and the TDEC CERCLA regulators.

**Recommendation 2-14:** The review team recommends aggressively pursuing the CERCLA remedial actions while optimizing the integration of NPDES and CERCLA regulatory framework. (Good Practices)

**Issue 2-15: Regulator and stakeholder support will be critical in achieving IFDP success.** Since designation on the NPL in 1989 and the effective date of the FFA (1992), ORO has demonstrated a capability to work collaboratively and effectively with the EPA, TDEC, and other local/regional community stakeholders. One of the most significant evidences of this interaction was the ORO receiving the community's endorsement of the Risk Based End State Vision and Planning document (DOE 2004). Through both the CERCLA process and where permitting actions might be required outside of the CERCLA framework, ORO has developed and maintained mature and productive relationships with both the regulators and community officials such that support for ORO efforts are typically received in a timely manner. Central to this approach, which embraces the principles of collaboration, coordination, and communication is the Environmental Program Council and the Core Team process. In this process, all regulatory stakeholders convene for the purpose of reviewing specific permitting actions or compliance issues and to work to resolve these issues, using the above principles, as swiftly and as equitably as possible.

**Recommendation 2-15:** This process should be supported and continued. ORO should also continue its highly successful working relationship with external stakeholders including both individual community members, community groups and other organizations (Site Specific Advisory Board, Environmental Quality Board, etc.). Such stakeholder support will be critical for achieving IFDP success, specifically in the area of on-site disposal of mercury-contaminated waste. (Good Practices)

**Benefits of Implementing Recommendations 2-11, 2-12a, 2-12b, 2-13, 2-14, and 2-15**

More aggressive CERCLA implementation will significantly increase the potential for Program success by reducing regulatory uncertainty. Such implementation activities will also have the benefit of retaining CERCLA flexibility for defining appropriate technical solutions while retaining the benefits of considering cost-effectiveness, implementability and state/community acceptance for specific selected remedial actions. In addition, like the IFDP itself, an integrated regulatory strategy will have the benefit of improving opportunities for compliance while maximizing the value of remedial actions

### 2.2.4 SAFETY, SECURITY, PROGRAMMATIC ISSUES

#### 2.2.4.1 SAFETY AND SECURITY RISK EVALUATION

The CD-1 report contains all the relevant attributes of adherence to the DOE safety and security programs requirements and commits to implementing an integrated safety management system and compliant security program. Accordingly, it is assumed that these are adequate and appropriate controls will be implemented during the conduct of work and this is not evaluated further by the review team. More emphasis has been placed on how the plan addresses safety and security risk and how that risk will be mitigated.

The safety risk of all the work defined in the work breakdown structure appears to have been reasonably characterized with a pre- and post-remediation risk ranking protocol that resulted in the highest safety and health risk items being addressed first from a sequencing standpoint. These high risk events were preferentially loaded into the first 5-year window of the IFDP project. The hard drivers for this prioritization included those items that present the highest safety or compliance risk. Note that there are several mercury specific safety and environmental release risks associated with the IFDP. IFPD has the potential to expose materials that are heavily contaminated with mercury and focus will be needed to avoid increasing the releases of mercury in the short or medium term. For example, care will be needed to avoid occupational inhalation exposure to mercury. Care will also be needed to assure broader environmental risk mitigation. For example, use of large volumes of water for dust control rather than misting systems might serve as a driving force to accelerate subsurface mercury migration to the UEFPC. However, given the well-documented, robust and disciplined safety program at the ORR, the review team did not identify safety issues to highlight at the CD-1 level.

An appropriate efficiency factor of 60% was included in the EM project baseline for work occurring within the controlled security area, and carried forward into the IFDP estimates. The risk register item assigns a total cost of $97M for security impacts with potential reductions to $10M if further facilitation of the cleanup work could be accommodated.

The CD-1 document appears to appropriately tie the necessary facilitated security measures to removal of the Perimeter Intrusion Detection and Assessment System (PIDAS) in 2018-logic tied to the Uranium Processing Facility becoming operational. If this does not occur, post 2018 costs will increase significantly. Mitigative actions recognize that in the interim, compensatory measures will help improve the efficiency of getting work done between now and 2018.

The following risks from the risk register in some fashion addressed the issues associated with security risk:

| | | |
|---|---|---|
| R-0027 | Additional Security Requirements | Low Risk |
| R-0050 | Reduction of PIDAS | Moderate Opportunity |

These risks attempt to bound the security risk and provide mitigative actions that could reduce impacts to the cleanup and remediation work. Notwithstanding, there appears to be issues relative to inclusion and institutionalization of the security program into the solution that could help better ensure success.

**Issue 2-16**: **The CD-1 does not document the impact of increased security requirements on cleanup performance.** Risk R-0027 only identifies a potential cost growth of $7M and no schedule impact associated with increased security requirements. This cost is only for the increased direct security costs and no impacts are identified for the cleanup program. This appears to be a bit myopic and not inclusive of all the potential impacts. In addition, the potential for increased security requirements appears to be more than a low risk.

**Recommendation 2-16:** Include in the quantification of impacts due to increased security requirements, the corresponding cost and schedule impacts on the IFDP Project during the CD-2/3 process. (Area of Concern)

**Issue 2-17: Opportunities for effectively providing necessary security while minimizing negative impacts on schedule for a project of this size and scope have not been sufficiently evaluated.** Small improvement in security procedures could yield significant benefits to the project implementation. Neither the mitigative actions in Risk R-0050, nor the Security Plan in Attachment D seem focused on trying to facilitate the reduction of security requirements on the IFDP work. The security program seems to be somewhat isolated and sacrosanct and not a part of the team with the charter to efficiently execute the IFDP.

**Recommendation 2-17:** The Transition Team identified in Attachment J should be modified to include someone with the mission and authority to explore efficiencies in security to facilitate such things as the ingress and egress of remediation and demolition personnel. Two examples provided in the Energy, Technology and Business Association Work Shop (ETEBA, 2008) were to: a) provide a reduced protection area or create islands of security; and b) provide dedicated shipping portals for waste. The Integrated Project Team includes security under the NNSA subteam. In practice, prioritization by the Senior Management Steering committee will be required to drive the above changes, as it is unlikely they will happen spontaneously.

#### 2.2.4.2 PROGRAMMATIC RISK EVALUATION

The CD-1 document, Risk Management Plan and detailed Risk Register were reviewed relative to major programmatic risks, specifically as they apply to the high risks assigned to the IFDP and the mercury treatment and disposal elements. These documents demonstrate that a very comprehensive effort went into the development of scope, cost, and schedule details that support the CD-1 alternative evaluation and cost range. Other aspects of Programmatic Risk reviewed included ownership transfer and funding.

The scope of work is clearly defined and supported by significant detail. This formed the basis for the total direct cost estimate of $5.7B. These costs were developed with activity based cost estimates for approximately $4.6B in new scope, and from the existing EM Validated baseline for the remainder. The allocation of the contingency appears to be appropriately weighted on the high risk events (>80%) for the entire IFDP. However, the proportion of direct cost to contingency for mercury remediation appears to be skewed toward contingency. The schedule to implement is estimated at 26 years and is supported with sufficient detail for this stage of the project.

The risk register appears to be sufficiently robust, and appears to largely define the suite of risks that could cause the highest risk to the Project, as well as moderate and low risks. Assumptions made on some of the high risks may significantly underestimate the total cost and schedule risk from a most likely and worst case perspective. Although, as pointed out in the risk register, better definition and quantification will occur at CD-2/3, a bounding range should be included in any recommendation to the Acquisition Executive at CD-1. Ownership Transfer risk is identified in R-0010, Facility transition to EM, and PPEP Attachment J, Facility Transition Plan. This is identified as a low risk and no schedule risk is assigned. In practice, it may prove to be a complex issue, highly dependent on the incumbent owner deactivating facilities in a timely manner, and could result in significant schedule impacts. The specifics of these issues, which are considered to be opportunities for improvement, are highlighted below:

**Issue 2-18: The assumptions used in some of the high risks for the IFDP appear to significantly underestimate the cost and schedule impacts of the most likely and worst case scenarios.** Specifically, the cost impact may be arbitrarily limited, and the schedule impacts are assumed to be zero for R-0004-Mercury Debris Treatment, 0012-Ability to meet mercury TMDL, and 0015-Ability to meet onsite WAC. These risks involve mercury treatment standards and disposal acceptance criteria.

**Recommendation 2-18:** For Risks R-0004, 0012, and 0015, expand the worst case impact to not artificially truncate. For Risk R-0004, add a worst case schedule impact as this will likely be critical path if occurs. For Risk R-0012, add more significant cost and schedule risk should the State toe the line on the lower TMDL basis of 0.3 mg/kg. For Risk R-0015, for the worst case, assume more than 10% of the waste may have to go toward offsite disposal. As the Project evolves and moves toward CD-2/3, better assess the risk mitigating actions and add to the risk register. (Technical Issue)

**Issue 2-19: No risk is identified that evaluates losing NTS disposal capability for MLLW after December 2010 and timing of new onsite disposal capacity.** There appears to be a disconnect between losing this capability in 2010, and the decision to expand the EMWMF in 2014. Neither Risks R-0009-NTS Charging Practice Changes, nor R-0015-Ability to meet onsite WAC, capture this issue.

**Recommendation 2-19:** Develop a risk assessment form for the loss of MMLW disposal capability at NTS post 12-2010. (Technical Issue)

**Issue 2-20: The majority of the schedule risk appears to be attributed to the availability of money.** The assignment of preponderance of schedule risk for the Project to Risk R-0031-Funding, which involves provision of level funding may significantly underestimate the total schedule risk exposure. Although the funding impact assumptions in this risk appear to be robust, they should be limited to funding uncertainty and not representative of the total Project Schedule Risk. The assumed annual funding variances of $40-80M are not uncommon these days and could easily contribute to the increased mortgage cost of $450M and schedule delay of 6 years assumed over the life cycle if they continue. This appears to be a legitimate risk; however, the schedule risk associated with other high technical and programmatic risks should be assessed independently as they most likely will significantly exceed this value. This also would be important to include in the cost and schedule range reported to the Acquisition Executive.

**Recommendation 2-20:** Schedule risk should incorporate technology uncertainties and other aspects of the project beyond availability of funding. (Technical Issue)

**Issue 2-21: The direct-cost-to-contingency ratio for mercury remediation work appears to be significantly skewed.** For mercury remediation, the direct cost is estimated at $180M while contingencies total $434M. This presents a programmatic risk in ability to execute the defined mercury scope at the assigned direct cost.

**Recommendation 2-21:** Reallocate the cost distribution for mercury remediation and balance the distribution between direct cost and contingency up to a level consistent with the CD-1 estimation. (Technical Issue)

**Issue 2-22: The rankings in the risk register may not have been applied consistently.** For example, the ranking of R-0008-Inadequate Contractor Performance, and R-0010-Facility Transition Issues as low risks may not be consistent with other risks in the risk register that could affect the ability to get the highest risks completed soonest. The following risks from the risk register in some fashion addressed the issues associated with remediating the highest risks first:

| | | |
|---|---|---|
| R-0006, R-0007 | Delay of D&D | High Risk |
| R-0008 | Inadequate Contractor Performance | Low Risk |
| R-0010 | Facility Transition Issues | Low Risk |
| R-0020, R-0021 | Discovery of Unexpected Hazards | High Risk |
| R-0025 | Adequate Contractor Resources | Moderate Risk |

These collective risks appear to adequately demonstrate sensitivity to this issue and ensure that planning will occur to mitigate. Notwithstanding, from a holistic standpoint, it appears like the ranking of R-0008 and R-0010 as low risks may not be consistent with the other risks in this category and would likely be closer to a moderate risk in terms of ability to impact the execution of the IFDP project.

**Recommendation 2-22:** Consider adjusting the ranking of R-0008 and R-0010 to a moderate risk to more closely align to similar risks. (Opportunity for Improvement)

**Issue 2-23: It is not clear that all the predecessor characterization activities and data compilation steps are factored into the plan for the first 5 years to ensure the ROD date is met.** The overall schedule adequately sequences the interim ROD actions throughout the lifecycle to ensure the progression of planned work. The first critical ROD change, a change to the existing EMWMF ROD, does not occur until 2014 when a decision on expansion of EMWMF is needed.

**Recommendation 2-23:** In the CD-1 Preliminary Project Execution Plan modify sections 3.5.5.1 and 3.5.5.2-ORNL and Y-12 Phase A Plan (FY2010-2014) to ensure that priority gets placed on the predecessor tasks, such as facility and media characterization and data compilation, and there are solid logic ties to support the finalization of the EMWMF ROD change by 2014. This will ensure that detailed work plans include this important objective. Also, risk will be reduced sooner if the change to the ROD can be obtained sooner. (Technical Issue)

**Benefits of Implementing Recommendations 2-16, 2-17, 2-18, 2-19, 2-20, 2-21, 2-22 & 2-23**
The cumulative benefit of implementing the above recommendations will be to more sufficiently bound the cost and schedule risk associated with IFDP for communication to the Acquisition Executive for decision making. In addition, it will result in a more appropriate distribution of costs between direct cost and contingency, and ensure that security programs are effectively integrated into the successful outcome of the IFDP.

# 3.0 FACILITY RECONFIGURATION

The IFDP Team has done a commendable job in developing reconfiguration alternatives for ORNL. The IFDP Team has bounded the cost of the project and provided a technically credible and complete basis for estimates at the CD-1 level.

As discussed in Section 1.2, the IFDP is a collaborative proposal developed to complete the environmental cleanup and at the same time enable ongoing modernization efforts at ORNL and Y-12. One important aspect of the IFDP is the reconfiguration of key systems, process areas, and buildings: 1) liquid and gaseous waste systems; 2) process/storage/staging areas for contact-handled and remote-handled solid wastes; and 3) utilities reconfiguration and relocation. The CD-1 report devotes an entire attachment (CDR Attachment C: Reconfigured and New Facilities Conceptual Design for the Oak Ridge Integrated Facility Disposition Project) to describe and justify the facility modifications for the IFDP. Tables 1-1 and 2-3 in CDR Attachment C listed each of the new or reconfigured facilities at ORNL and Y-12, respectively. These tables were used by the Facilities Team as a reference point to determine how best to divide the review/writing assignments amongst the team members, then again as a means to expand and summarize facility-specific issues and recommendations.

The Facilities Team used a graded approach in reviewing the facilities, spending more time and effort on the most expensive and most complicated of the proposed reconfigurations. However, the Team checked on some of the lower cost facilities to see if they were described, justified and technically acceptable at the CD-1 level. The Team found the new and reconfigured facilities were described sufficiently for reviewers to understand what is proposed, that the IFDP has documented their justification, and that CD-1 level of information has been developed and presented. Several of the Facilities Team recommendations suggest actions that can be taken during CD-2 to further develop the reconfiguration package sufficient to allow full consideration of alternative means to achieve the same end point and for authorization to proceed. These recommendations are in agreement with statements in the CD-1 document (Section 3.2.3 of the PPEP) that state prior to approval of CD-2, the new facilities will undergo additional analysis for comparison with existing systems to provide the necessary functions to meet the required performance at the overall life-cycle cost.

The graded approach used to conduct this review resulted in the "grouping" of like systems or processes. Each group was reviewed along the lines of inquiry established for Facility Reconfiguration. Similarly, background information and current conditions for each group was presented with the results of the review. Section 3.1 discusses overarching or cross-cutting issues and technology-related recommendations that affect or could affect many of the new or reconfigured facilities; Section 3.2 addresses remote-handled (RH) solids and liquid low level waste (LLLW), which in the Team's view are closely inter-related and both require remote-handling facilities; Section 3.3 addresses process wastewater, gaseous waste and groundwater systems; and Section 3.4 discusses reconfiguration of utilities at the Y-12 Facility.

## 3.1 CROSS-CUTTING ISSUE IN THE RECONFIGURATION OF ORNL AND Y-12

The following is an issue that applies to the Facility Reconfiguration portion of the IFDP and that affects, or could affect a number of systems, processes, and buildings proposed for reconfiguration.

**Issue 3-1: The justification and timing for the D&D of the existing facilities needed for the landlord mission (e.g. 3525 and 3025E at ORNL) and the capability and flexibility needed in the replacement facility was not clear to the ETR Team.** The goal of the reconfiguration of ORNL and Y-12 is to make it possible to "eliminate the high risk legacies of the Manhattan Project and Cold War, complete the environmental cleanup mission, and enable ongoing modernization of the ORNL and Y-12." The Oak Ridge objective of the IFDP is to remediate the sites and to make strategic real estate available for continuing and future missions of ORNL and Y-12. However, although it may be desirable to remove the nuclear facilities to Melton Valley and to leave existing facilities available for future missions, that is a policy choice and not a mandate. Consequently, the ETR Team could not clearly identify the technical and regulatory requirements for 1) the relocation of the landlord facilities, and 2) the specific technical requirements of the new facilities. For example, the team could not discern from the available information the projected technical requirements of future SC missions in the RH Solids facility as contrasted with IFDP requirements to process waste generated for D&D of ORNL facilities. Also, the ETR was concerned with the forecasting of potential programs that will utilize this facility.

Perhaps the most important factor to consider in planning the modernization of the infrastructure of the sites, is to forecast the requirements for some future time. However, one must project possible futures so that essential facilities that require years to design and build will be in place at the time that they are needed. The question facing ORNL and Y-12 as they try to modernize their facilities, is for how far into the future should they be built. This is the same question that must be asked for many parts of the national infrastructure including roads and bridges, water supply systems and waste water treatment facilities. In this situation, it must be recognized that there is great uncertainty in any forecast of future needs and the facilities should be modified or new facilities built that easily allow modification or expansion.

The uncertainty in demand and in technical needs would imply that any new or reconfigured facilities should be designed and built with the flexibility so that changes in the equipment and technology could be more easily incorporated. A key issue for the proposed hot cell facilities is how to balance the design so that specific mission needs can be met while still being flexible enough to accommodate future needs and equipment installation. This dilemma is compounded when a proposed facility attempts to support diverse mission needs.

Moreover, the policy choices of how to do things could change as a result of changes in the input factors. For example, if DOE's plans for future work on the Global Nuclear Energy Partnership (GNEP) were altered in scope or timing, how would that impact the future need for the capabilities represented by the existing 3525 and 3025E facilities? Even if the GNEP program were eliminated, is it important to DOE to maintain the type of hot cell capabilities to perform R&D on spent nuclear fuel during this country's nuclear renaissance, which is represented by these facilities? These issues should be fully examined and documented during the CD-2 phase of the project, though considerable uncertainty of future needs at that time will still remain. These considerations lead to the first recommendation of the Facilities Team:

**Recommendation 3-1:** During CD-2, more information on the Department's need for maintaining the mission capabilities at ORNL and Y-12, what the expected future utilization will be, and the duration of the expected future mission needs for that research capability should be fully explored and documented. Further, the IFDP Team should clearly identify factors (e.g., are there alternatives to maintaining 3525 and 3025E as active facilities and still meet the requirements of IFDP remedial actions) that affect the decisions relating to the nuclear facilities that would be relocated from Bethel Valley to Melton Valley. (Opportunity for Improvement)

**Benefits of Implementing Recommendation 3-1**

A clear identification of factors supporting the preferred approach to facility configuration will ensure that when the CD-2 documentation is reviewed, there will be more information available to the reviewers and decision makers. Impacts on the alternatives due to the decision to move nuclear facilities and their operations to Melton Valley would be better understood. Insufficient information was available related to mission needs and timing, to be able to determine whether and how the strategy of moving nuclear operations to Melton Valley affects the alternatives evaluation and selection process.

Further, developing a sound programmatic and technical basis for the proposed facilities during CD-2, especially in terms of the RH solids and LLLW facilities, will allow decision makers to understand and evaluate the scope and priority that should be associated with the future mission needs (especially with respect to DOE and other agencies' needs related to 3525 and 3025E).

## 3.2 REMOTE HANDLED SOLIDS AND LIQUID LOW LEVEL WASTE CAPABILITY

### 3.2.1 CURRENT CONDITIONS

The D&D and remediation of the ORNL campus, especially in Bethel Valley, will eliminate a large number of excess facilities currently managed by EM and SC, as well as facilities that contribute uniquely to ORNL's capabilities. Buildings 3025E and 3525 (two operating hot cell facilities) provide materials characterization capabilities that are primarily conducted within hot cells. New facilities with these capabilities are proposed to be located in Melton Valley. The existing facilities will undergo D&D in order to provide access to underlying soil and groundwater for remediation to meet the IFDP final ROD requirements, and desired land use end-state in the Central Campus. The aging LLLW treatment facility, located in the in the Central Campus, is connected to generating facilities by miles of deteriorating underground piping. The LLLW System will undergo D&D, and a new, "right sized" system is proposed to be located in Melton Valley to provide treatment for LLLW generated in the future. This will eliminate the need for some of the piping.

Processing of RH solid waste, and of sludge generated by the LLLW system will be accomplished at the Transuranic Waste Processing Center (TWPC). The TWPC has the capability to handle certain CH-TRU waste and repackage and certify the material for shipment to WIPP. The TWPC also has the capability to process certain liquid and sludge waste for shipment to NTS or WIPP. The facility has a hot cell that can receive RH-TRU waste packaged in ORNL standard concrete casks for repacking, certification, and shipment to WIPP.

#### 3.2.1.1 TYPES AND QUANTITIES OF WASTE MATERIALS

Future RH solid waste and LLLW have been estimated based on impacts expected from IFDP predicted changes in R&D missions and (Table provided by Sharon Robinson in July 15 briefing). Table 3.1 summarizes the current and projected future RH solid and LLLW generation rates.

**Table 3.1 ORNL RH Solid waste and LLLW Waste Projections**

| Waste Stream | Waste Generated During IFDP | Waste Generated After IFDP |
|---|---|---|
| ***Liquid Low-Level Waste*** | | |
| LLLW | ~260,000 gal./yr | ~25,000 gal./yr. |
| ***RH Solid TRU and LLW Waste Projections*** | | |
| IFDP Legacy Waste | ~300 $m^3$ | 0 |
| IFDP D&D Waste | ~600 $m^3$ | 0 |
| IFDP RA Waste | TBD | 0 |
| DOE SC Mission | ~10 $m^3$/yr | ~10$m^3$/yr |

#### 3.2.1.2 CURRENT REGULATORY STATUS

The current LLLW system is operating under the onsite wastewater treatment unit exclusion under RCRA for facilities that are subject to regulation under Section 402 or 307(b) of the CWA, meet the definition of a tank, and are handling wastewater or wastewater treatment sludge. Closing the current system and building a new one will entail permitting (CWA/NPDES, at a minimum, and possibly RCRA depending on the nature of the wastewater/system design/treatment process) of the new system. If the regulatory issues associated with the new facility have not yet been addressed, it will be necessary to do so in depth at the CD-2 level. The solid TRU waste facilities at ORNL are, generally, RCRA permitted, and the expectation is that future TRU waste facilities will also be RCRA permitted. If there are potential regulatory issues, those will need to be addressed in the CD-2 process for solid wastes also.

#### 3.2.1.3 ALTERNATIVES EVALUATED

The alternatives evaluated and analysis performed to select the preferred alternative are fully developed in the Alternative Analysis for ORNL Reconfigured Capabilities in Support of the Integrated Facility disposition Project, May 2008 Draft. The alternatives are well analyzed in the supporting documentation. However, as discussed below, the ETR team found that the alternatives analysis did not completely consider all potential RH solid and LLLW treatment systems available to ORNL, such as modifications to the TWPC.

#### 3.2.1.4 CURRENT CD-1 RECOMMENDED ALTERNATIVE

The recommended or preferred alternative is to construct a facility for treatment of LLLW and a co-located facility for all solids materials processing.. These materials include LLLW, IFDP legacy and D&D waste, and other ORNL mission generated materials.

The preferred alternative in the Alternatives Analysis document indicates that LLLW treatment and RH material handling will be in a common facility. That alternative changed based on further analysis. The CD-1 preferred alternative is separate but co-located facilities for RH materials processing LLLW processing. This section of the report will summarize the results for both the RH handling and LLLW facilities.

### 3.2.2 EVALUATION OF CD-1 RECOMMENDED ALTERNATIVE

#### 3.2.2.1 OVERALL COMPLETENESS OF ALTERNATIVES EVALUATION

As stated previously, the IFDP team has done a commendable job in developing reconfiguration alternatives for ORNL. The team has bounded the cost of the project and provided a technically credible and complete basis for estimates at the CD-1 level. Further, The ORNL team has indicated in both their presentations and the Options Analysis document (***Alternatives Analyses for ORNL Reconfigured Capabilities in Support of the IFDP,* May 2008**) that they plan to more thoroughly evaluate the possibility of using the TWPC for processing RH solid wastes and LLLW during the CD-2 phase. It is recommended that they approach the possibility from a perspective of how much of the legacy waste and waste resulting from the "de-inventory" of ORNL facilities can be processed either in advance of the IFDP or in the early years of IFDP. Disposition of RH waste is expensive and often difficult, so it is frequently deferred.

#### 3.2.2.2 TECHNICAL FEASIBILITY AND EFFECTIVENESS

One IFDP goal is to reconfigure facilities, as needed, to support IFDP. One objective, "Reconfigure Waste Management facilities to maintain viable waste treatment processing capabilities at completion of IFDP" (*Alternatives Analyses for ORNL Reconfigured Capabilities in Support of the IFDP,* May 2008), is the reconfiguration of the ORNL LLLW system.

Processing of RH and RH-TRU solid waste is presently accomplished at the Transuranic Waste Processing Center (TWPC) where RH solids are repackaged and certified for shipment to NTS (if LLW) or WIPP (if TRU). The TWPC was designed for a specific mission. However, the facility has broad capabilities with respect to RH waste processing and is a Hazard Category 2 nuclear facility. The TWPC, with modification, has the capability to remain active for the foreseeable future. One other facility, the Building 3047 hot cell, is proposed to be modified to process RH waste throughout much of the IFDP schedule.

LLLW system facilities are located throughout ORNL, including:

- LLLW collection/storage tanks, which are located near the generator facilities;
- LLLW Evaporator Facility (Building 2531), which is located near Third Street and White Oak Avenue in the ORNL Central Campus and includes five 50,000-gallon (gal) double-contained LLLW collection/storage tanks, which are known as the Bethel Valley Evaporator Service Tanks (BVESTs);
- The Melton Valley Storage Tanks (MVSTs) system, which is located in Melton Valley and which includes eight 50,000-gal tanks and six 100,000-gal tanks.

The LLLW system collects, adjusts the pH, concentrates, and stores aqueous radioactive waste solutions for future solidification at the TWPC with final disposal at WIPP or NTS.

ORNL proposes to replace this system, in conjunction with a RH solids handling facility, and establish the capability at the Melton Valley Nuclear Facility Complex (MVNFC). The new system will optimize the design and provide technologies that allow the LLLW and treatment residues to be disposed. This approach is technically feasible. However, several issues (see below) were identified that should be considered further to ensure thorough evaluation of technologies that can reduce cost, safety and environmental risk, and ensure the waste generated by IFDP as well as research programs at ORNL will be treated in compliance with applicable regulations and/or waste acceptance criteria.

The ETR Team found that the IFDP Team has analyzed the reconfiguration of waste management facilities at ORNL by identifying potential wastes to be handled as well as identifying the scope and technical requirements for the proposed new facility. The project has documented both the technical requirements and planning assumptions, and has generated a comprehensive cost estimate for proposed new facilities. The CD-1 documentation provides a credible bounding estimate of the requirements to reconfigure the ORNL waste facilities in support of the IFDP. However, this bounding estimate (which would approach $500M if it was a stand-alone line item project) will require extensive value engineering assessment, justification and evaluation of alternatives as the IFDP moves forward through its approval process.

**Issue 3-2: The CD-1 documentation did not identify the trenchless technology as a possible alternative at either ORNL or Y-12, although both sites have many existing pipelines in and through contaminated areas.** Trenchless technology could be used for installing pipes underground at either site in Oak Ridge. This technology is not only state-of-the-art, it is also state of the practice and well proven in many applications. Without knowing the details, it is not possible to give site-specific details or estimates. However, it is quite practicable to install pipes within existing pipes in an environment such as ORNL and Y-12. There are many options including removing the existing pipe, installing new pipe into the existing pipe or along side it, and manufacturing and installing the new pipe inside the existing pipe. The costs can vary from $50 to $500/linear foot depending upon a number of factors including the diameter of the existing pipe. The average cost is about $100/linear foot (personal communication, Sanjiv Goghale). These costs contrast with the estimated cost of $1,000/linear foot for open trench pipe installation at ORNL (cost information provided by Chris Scott during July 15, 2008 briefing for ETR Team).

**Recommendation 3-2:** During CD-2, the IFDP team should consider (and should document the evaluation) for use of technologies for working in and around contaminated sites such as ORNL and Y-12. Specifically, the technology for installing pipes in existing underground pipes should be explored as part of the alternatives evaluation and the results of those evaluations clearly documented. (Technical Issue)

**Benefits of Implementing Recommendation 3-2**

The benefit of this recommendation is the potential for less costly underground piping, less disruption of ongoing and surface activities, and less risk for workers, any or all of which could change the conclusions and approaches at either ORNL and/or Y-12.

**Issue 3-3: The evaluation of alternatives for both RH solids and LLLW systems did not appear to adequately assess all the capability available to ORNL.**

<u>RH Solid Processing Capability -</u> A key assumption in the CD-1 planning at ORNL, consistent with the recently validated EM Baseline, was that the TWPC would be used for its current EM mission to characterize, package and dispose of ORNL's legacy solid waste and sludge, and that it would be deactivated and decommissioned at the end of this campaign. However, the TWPC physical plant has extensive capabilities which could process much of the RH solid waste anticipated to be generated during the IFDP, and this was not adequately considered. Further, the TWPC has an approved characterization and certification program in place for shipping both CH-TRU waste to the Waste Isolation Pilot Plant (WIPP) and low-level waste (LLW) to the Nevada Test Site (NTS). The difficulties, time and

expense necessary to implement and qualify these waste certification programs should not be underestimated. The option of using the TWPC for the wastes that can be processed within the technical capabilities of the facility as well as its safety basis has the potential to save time and considerable cost. Additionally, TWPC processing capacity is scheduled to be available for solid processing about 2013 as its current mission comes to a close, which is much earlier than a new facility can be designed, funded and built.

**Recommendation 3-3a*:*** During the CD-2 phase, a comprehensive evaluation of RH solid waste alternatives at ORNL should be completed. (Technical Issue)

**Benefit of Implementing Recommendation 3-3a**

Opportunities for direct disposal and use of existing facilities to process the waste that can not be disposed without further processing should be fully investigated. Direct disposal can be achieved either using existing profiles for similar waste (e.g. some of the RTGs can be disposed at NTS using profiles developed by others) or by exploring waivers for waste acceptance for packages that would be difficult to re-work. Based on the presentations and CD-1 documentation, the IFDP team has done a good job of bounding the processing options for RH solid wastes, identifying legacy RH wastes and the potential RH wastes that will be generated when removing the wastes from the hot cells and other RH facilities before D&D. The IFDP team apparently then used that master list of difficult to process RH wastes to identify facility requirements to ensure successful disposition of this waste. This strategy has led to a proposed solid waste facility that meets the needs of the IFDP and is usable for future mission needs at ORNL. However, this option would require considerable capital investment. It appears that the technical requirements associated with a small portion of the projected IFDP wastes at ORNL have driven the design of the facility (e.g., the capability to process the highest dose wastes, as well as the largest and heaviest waste packages).

**Recommendation 3-3b*:*** During the CD-2 phase, a RH Waste Focus Team should evaluate handling and disposition for difficult to process waste. Any difficult waste that will require the use of an ORNL facility on the D&D list must be scheduled and completed before the facility D&D. (Technical Issue)

**Benefit of Implementing Recommendation 3-3b**

The project risk and future liabilities could be significantly reduced by identifying ways to use existing facilities to disposition waste. The approach taken in the CD-1 to propose a comprehensive new hot cell facility for RH solid waste to meet the IFDP and the mission needs by replacing the 3525 and 3025 hot cell facilities (for spent nuclear fuel R&D) with new hot cells with enhanced capability has served to bound the problem. The more detailed evaluation of alternatives recommended for the CD-2 phase will provide the decision makers the information to choose alternatives based on priorities as well as sequencing and phasing of the work.

<u>LLLW Processing Capability –</u> The unit operations in the current LLLW treatment system coupled with those in the

TWPC are adequate to process and prepare for disposal the projected LLLW generated by the IFDP. The Alternatives Analysis was initially performed assuming that the administrative decision that TWPC would not be available to process either RH solid waste or LLLW after 2016 would not be reconsidered. Shutdown in 2016 is necessary to allow the TWPC to cease operations consistent with completion of its mission in 2018/2019. Subsequent qualitative analyses were performed that evaluated TWPC capabilities to support this IFDP scope. However, the results of the analysis did not identify the TWPC as a preferred alternative to process LLLW in support of IFDP.

The schedules for shutdown of the existing LLLW system and TWPC, and startup of the new LLLW and RH solids processing and staging/storage facilities need to be revisited during CD-2 to avoid the temporary loss of waste treatment capabilities for IFDP. A review of the schedules available in the PPEP, Attachment B, shows the current LLLW system will undergo D&D beginning in early 2020 which is when the reconfigured LLLW system is expected to come on line. Similarly, the TWPC is projected for shut down in 2018 with D&D starting in 2019. Related facilities, which are required to package and store/stage the RH TRU waste generated by the reconfigured LLLW facility for transport to WIPP, will be available in 2022. There appear to be inconsistencies in these schedules. There will be limited capability available to process radioactive liquid wastes for disposal between 2018/2019 (the close of the TWPC) and 2022 (the opening of the RH handling facility in the MVNFC). Further, the TWPC will be required to process large volumes of materials transferred from the Bethel Valley Storage Tanks (BVSTs) as the existing LLLW system is prepared for closure and D&D in 2020. Consequently, it appears that the sludge/supernatant treatment capability available through the TWPC will be required through at least 2020-2021. Though the IFDP Team has evaluated modification to the TWPC to process liquid waste as an alternative to providing LLLW processing capability at the MVNFC, it was not as detailed a study as the preferred alternative.

As a historical note, when planning for the IFDP was initiated, the TWPC was privately owned, and focused narrowly on its mission. Now that the TWPC is a DOE facility, the DOE personnel and the EnergX personnel that are operating the TWPC are open to evaluating the possibility that the life of the TWPC could be extended and the facility could be modified as necessary to support the characterization and packaging of IFDP waste (personal communication, Doug Turner and TJ Abraham documenting the interview on July 7, 2008 with Bill McMillan et al concerning the potential future use of the TWPC for IFDP waste).

**Recommendation 3-3c: The IFDP team needs to evaluate the feasibility of modifying the TWPC to provide long-term LLLW treatment capability as an alternative to the MVNFC LLLW treatment system.** (Technical Issue)

**Recommendation 3-3d: The IFDP team needs to carefully review the D&D schedules shown in the CD-1 and determine if LLLW treatment and RH solids processing and staging/storage capabilities will be available when needed.** (Technical Issue)

**Benefits of Implementing Recommendations 3-3c and 3-3d**

Opportunities for processing the LLLW generated during IFDP exist within current facilities at ORNL if treatment at the TWPC is considered. Significant cost savings and reduced schedule risk may be realized by treating LLLW at the TWPC rather than depending on the construction of a new facility.

#### 3.2.2.3 REGULATORY & STAKEHOLDER ACCEPTANCE

ORNL, as mentioned earlier, has made a policy decision to consolidate nuclear operations in Melton Valley. Consequently, the contractor and DOE Oak Ridge stakeholders strongly support the preferred alternative. It does not appear that there would be strong objections from any other regulatory or stakeholder groups. The one issue that will need to be addressed in more detail during CD-2 is how the NEPA process will be applied to the proposed new facilities. The PPEP indicates that the CERCLA and NEPA processes will be followed for the new facilities, and as the planning progresses, the level of detail will need to be increased.

#### 3.2.2.4 SAFETY, SECURITY, PROGRAMMATIC ISSUES

**Issue 3-4: The IFDP team expressed significant concern about safety basis requirements as they relate to modification of facilities. These concerns may have biased analyses results in favor of new facilities in lieu of modifying existing facilities such as the TWPC.** The IFDP team expressed concern that the modification of the TWPC may be difficult or impossible when DOE safety basis requirements are considered. One significant concern is that the requirements under DOE STD 1189 Integration of Safety into the Design Process could not be met, and the team considered this a major program risk. The ETR team agrees that there may be safety basis issues associated with both major modification and new facilities. These issues are manageable (personal communication with J. Mullis) and need to be considered in context with other issues associated with development of new facilities in the DOE system. .

**Recommendation 3-4:** The IFDP team needs to ensure that the utilization of the TWPC has been completely evaluated from a nuclear safety perspective.

**Benefit of Implementing Recommendation 3-4**

A thorough analysis of nuclear safety requirements for modifying TWPC will allow consideration of the TWPC for processing more of the IFDP waste.

## 3.3 PROCESS WASTE, GASEOUS WASTE AND GROUNDWATER

There are separate systems for addressing process wastewater/groundwater and gaseous waste. Each system is discussed separately in the following sections.

### 3.3.1 CURRENT CONDITIONS

Process Wastewater and Groundwater - Collection and treatment of process wastewater and groundwater, at ORNL and the conditions that will exist after remediation efforts associated with the Integrated Facilities Disposition Project (IFDP) and the alternatives for treating current and future process wastewaters and ground water are reported in detail in “Treatment Alternatives For Process Wastewater At ORNL”, ORNL/CF-0603-R1, Nov 2007.

Contaminated groundwater from the central ORNL campus in Bethel Valley is expected to generate ≥70% of the future wastewater requiring treatment. Contaminated groundwater from remediated waste disposal sites located in Melton Valley is expected to generate ~20%. The EMWMF and R&D generated process waste water is expected to generate ~10% combined.

More recent missions, such as the Spallation Neutron Source (SNS), plan to treat their process wastewater on-site to remove radionuclides and then discharge the water to the sanitary system. Wastewater that does not meet the waste acceptance criteria for the sanitary system would be collected and trucked to the PWTC for future treatment system.

4500 Area Gaseous Waste System - The 4500 Area Gaseous Waste System is reported in detail in “Preliminary Proposal for the 4500 Area Gaseous System Upgrades”, PP No 1026, 6/6/05. The central gaseous collection system (1900 ft of underground concrete ductwork) is over 50 years old and has never been upgraded Visual inspections performed in the 1980s indicated deterioration of most duct joints, tree roots growing into the piping, and groundwater/rainwater in-leakage (> 40 gpm during heavy rains) into contaminated ductwork (some contaminated with TRU materials).

Rainwater in-leakage into the system has significantly increased since the 1980 inspections, and contaminated water flows through the concrete ductwork into the Building 4501 basement during periods of heavy rain. Replacement of this ductwork is needed to eliminate potential environmental and operational vulnerabilities.

#### 3.3.1.1 TYPES AND QUANTITIES OF WASTE MATERIALS

Process Wastewater and Groundwater - A brief description of wastewater source, volume, projected volumes, contaminates and explanation of change in projected volumes is given in Table 3.2.

**Table 3.2 Estimated Current and Future Process Wastewater and Groundwater flow**

| Wastewater Source | Current Generation Rate (gpm) | 2020 Generation Rate Projection (gpm) | Radionuclide Contaminates |
|---|---|---|---|
| Bethel Valley Groundwater | 100 | 50-100 | Cs, Sr, Hg, organics, metals |
| Bethel Valley R&D Waste | 80 | 0 | Sr and others below regulatory limits |
| Melton Valley Groundwater | 30 | 10-30 | Cs, Sr, organics, metals |
| Melton Valley R&D Waste | 7 | 7 | Am, Cr, Co, Cu |
| All other | 14-16 | 7-10 | Various |

4500 Area Gaseous Waste - The flow rate for the 3039. stack currently averages 130,000 SCFM (standard cubic feet per minute). Contaminants include 11,000 mCi/yr H-3, 1820 mCi/yr Pb-212, 95 mCi/yr Os-191, 1.5 mCi/yr I-135, and 1 mCi/yr I-133.

In-leakage of rainwater into the underground ducts to the 3039 Stack is a source of contaminated water that requires collection, sampling and treatment. Disconnecting the 3039 Stack will eliminate the expense of collecting and processing the water.

#### 3.3.1.2 CURRENT REGULATORY STATUS

Process Wastewater and Ground Water - The discharge from the process wastewater treatment complex (Bldg 3608) is in compliance with the current NPDES permit and a new permit will become effective on 8/1/08.

4500 Area Gaseous Waste System - The gaseous waste discharge is in compliance with the Rad NESHAPs limits.

#### 3.3.1.3 ALTERNATIVES EVALUATED

Process Wastewater and Ground Water - Six alternatives were evaluated for future treatment of GW and PW at ORNL . The evaluations used information from previous studies that looked at using a single centralized treatment facility, localized treatment facilities located at each major source of wastewater, and using a combination of local and centralized treatment facilities for future groundwater and process wastewater treatment (Treatment Alternatives For Process Wastewater at ORNL, ORNL/CF-0603-R1, November 2007; HFIR and REDC Process Waste Drains and Waste Treatment Plant, ORNL Facilities Development Division, 2003; Feasibility Study for the Upgrade of the Process Waste Treatment System, ORNL/TM-1000/65, May 1999; Feasibility Study and Cost Estimate for the Upgrade of the Process Waste Treatment System, ORNL X-OE-795, February 18, 1998).

4500 Area Gaseous Waste System - Three alternatives were evaluated for future treatment of gaseous waste at ORNL. These alternatives are discussed in the documents referenced above.

#### 3.3.1.4 CURRENT CD-1 RECOMMENDED ALTERNATIVE(S)

Process Wastewater and Groundwater - The current recommended alternative is Upgrade Building 3608 to treat groundwater, build a skid mounted waste treatment facility to treat the Melton Valley process wastewater, and reroute some process waste drain lines in Bethel Valley (from buildings generating incidental process wastewater) to sanitary manholes for transfer to the sanitary facility for treatment. In this preferred option, Building 3608 is upgraded to accommodate groundwater, rather than building a new facility. Building 3608 is located on the southern edge of the IFDP remediation area in the general vicinity of the largest groundwater generation site. Additionally, the Melton Valley process wastewater is treated in a new facility near major generators and the process wastewater in Bethel Valley is treated at the ORNL sanitary system.

4500 Area Gaseous Waste System - The current recommended alternative of the 4500 Area Gaseous Waste System is Construct Localized Gaseous Waste Systems for Buildings 4501, 4505, and 4500N. This option supports DOE-SC and DOE-EM program goals. This option also addresses operational and environmental vulnerabilities caused by water leakage into existing contaminated underground ductwork.

### 3.3.2 EVALUATION OF CD-1 RECOMMENDED ALTERNATIVE(S)

#### 3.3.2.1 OVERALL COMPLETENESS OF ALTERNATIVES EVALUATION

Process Wastewater and Groundwater System - The recommended alternative is appropriate for treatment of process wastewater and groundwater, and should be pursued in CD-2 where design, budget and work schedule will be developed in more detail.

4500 Area Gaseous Waste System - The recommended alternative is appropriate for treatment of the 4500 Area gaseous waste, and should be pursued in CD-2 where design, budget and work schedule will be developed in more detail.

#### 3.3.2.2 TECHNICAL FEASIBILITY AND EFFECTIVENESS

Process Wastewater and Groundwater System - The alternative suggested in the CD-1 documentation is technically feasible for treating the process wastewater, the groundwater at Melton Valley and Bethel Valley, and the EMWMF leachate. The technologies proposed for the selected alternatives are: For groundwater the technologies are filtration, air stripping, activated carbon, and zeolite to remove volatile organics, Sr, and Cs to less than discharge limits. For the Melton Valley R&D wastewater, ion exchange resins will be used to remove Cr, Am, Be, Cs and other metals. The EMWMF leachate treatment technologies will use the same technologies as for groundwater.

4500 Area Gaseous Waste System - The localized treatment system suggested by ORNL for the 4500 Area is technically feasible, effective and will allow for the D&D of the Central Gaseous Waste System..

#### 3.3.2.3 REGULATORY & STAKEHOLDER ACCEPTANCE

Process Wastewater and Groundwater System - The discharge from the process wastewater treatment complex (Bldg 3608) is in compliance with the current NPDES permit and a new permit will become effective on 8/1/08. There is general support for current discharge levels and discharge from the new system will be less than current levels.

4500 Area Gaseous Waste System - The gaseous waste discharge is in compliance with the Rad NESHAPs limits. There is general support for current discharge levels. The volume of discharge will be dramatically less with the localized system, while continuing to meet NESHAPs limits.

#### 3.3.2.4 SAFETY, SECURITY, PROGRAMMATIC ISSUES

There are no safety and security issues associated with the recommended alternatives for process wastewater, groundwater, and gaseous waste systems.

**Issue 3-5: The evaluation of alternatives for the process wastewater and groundwater reconfiguration of ORNL made an assumption that conventional, doubly-contained steel piping would be required to connect process water treatment capabilities in Bethel and Melton Valleys.**

**Recommendation 3-5:** The alternatives for these wastes need to be re-evaluated, reflecting the estimated cost of alternative such as trenchless piping referenced in Section 3.2.

**Benefit of Implementing Recommendation 3-5**

The potential for less costly underground piping, less disruption of ongoing and surface activities, and less risks for workers could result in a change to this recommended alternative and reduce project cost.

## 3.4 Y-12 FACILITY RECONFIGURATION

Reconfiguration of Y-12 utility infrastructure to support IFDP comprised over 75% of the budget for this WBS element at Y-12 ($95M), with the remaining 25% associated with construction of a solid waste treatment facility ($20M), and a portable liquid waste treatment unit ($8M). The latter two items were not reviewed due to their small relative contribution to the facility reconfiguration budget for the IFDP in general as well as at Y-12 specifically. Current waste and regulatory issues pertaining to utilities operation/condition at Y-12 are not as extensive as for portions of IFDP discussed previously in the document. Section 3.4.1therefore provides brief summary of current conditions.

### 3.4.1 CURRENT CONDITIONS

Execution of the Integrated Facilities Disposition Project (IFDP) will require significant changes in the configuration of utilities and support systems serving the Y-12 National Security Complex. Moreover, all such efforts must be performed so as to eliminate any potential for interruption in or pose a threat to critical utilities serving ongoing Y-12 national security missions. Y-12 was originally developed in the early 1940's as a uranium enrichment plant based on electromagnetic isotope separation technology (e.g., calutron). Wartime urgency for development and deployment of this technology resulted in a centralized utility service to the plant with subsequent facilities containing process equipment serially connected to these services through each other. This "daisy chained" approach created an inventory of facilities that are interdependent for continuity of utility service. This design complicates demolition of selected facilities at Y-12 without interrupting utility service to buildings that are not part of the IFDP.

### 3.4.2 EVALUATION OF CD-1 RECOMMENDED ALTERNATIVE(S)

#### 3.4.2.1 OVERALL COMPLETENESS OF ALTERNATIVES EVALUATION

Overall, the preferred alternative for utilities reconfiguration proposed in support of IFDP activities at Y-12 appears complete and adequately addresses programmatic, stakeholder, regulatory, safety and security issues identified in the CD-1 documentation. This conclusion is based on discussions held with IFDP project staff as well as a review of the detailed estimate for this scope of work. The IFDP project staff recognizes that additional opportunities may be available to lower costs associated with utility relocation through further optimization of work packages to eliminate unnecessary scope and material purchases, and will explore these opportunities as a function of CD-2. However, the preferred alternative, as defined at present, offers the maximum opportunity for success with minimal risk of scope growth subsequent to project initiation.

**Issue 3-6: Utility reconfiguration planning at Y-12 in support of the IFDP relies on reconstruction of existing system connections to bypass buildings targeted for demolition in the IFDP. The IFDP Team indicated that little effort was invested in determining the most efficient means of isolating facilities in preparation for demolition.**

**Recommendation 3-6:** The IFDP Team should incorporate value engineering assessments into CD-2 efforts to ensure cost effective and efficient utility reconfiguration on a facility by facility basis. For example, analyses should determine whether to re-route cooling water lines or install facility specific chillers; re-route compressed air or install a single or multiple stand alone units. In presentations for the ETR, the IFDP team indicated that such assessments have been planned as part of the CD-2 process to determine the most appropriate path forward. (Technical Issue)

**Benefit of Implementing Recommendation 3-6**
This would allow the facilities that need to continue operating to do so during D&D of the excess facilities.

#### 3.4.2.2 TECHNICAL FEASIBILITY AND EFFECTIVENESS

The method of accomplishment described in the CD-1 document package developed to support the IFDP is to construct bypass utility services around IFDP targeted facilities at Y-12 in preparation for demolition. This scope includes the construction of new electrical, chilled water/brine, plant air, communication lines, alarm systems, sanitary systems, etc. Each parallel line will be tested then placed into service before cutting the original line serving the targeted facility. This methodology will significantly limit the potential for service interruption to critical ongoing national security missions underway at Y-12.

This strategy is likely the most costly means of isolating IFDP targeted facilities at Y-12. , Little effort has been invested to validate the need for and optimization of utility reroutes. However, this strategy offers the least risk of technical difficulty or failure as well as scope growth. Project risk is effectively minimized through this approach. Accordingly, the ETR team believes that the preferred approach described in the IFDP CD-1 documentation competently captures and addresses costs and uncertainties associated with utility reconfiguration to support the project at Y-12.

#### 3.4.2.3 REGULATORY & STAKEHOLDER ACCEPTANCE

Relocation of utilities at Y-12 will require some excavation of potentially contaminated soils (e.g., installation of new duct banks, for example). These soils will have to be managed in accordance with relevant environmental regulations (CERCLA and/or RCRA). The CD-1 documentation reviewed has considered this requirement and has accounted for the marginal effort needed to comply with these requirements.

With regard to occupational safety and health (OSHA) workplace safety requirements, the preferred strategy limits interaction with energized electrical services, as well as charged air, water, and steam lines with the exception of tie in points at both ends of the targeted facility.

The primary stakeholder associated with this portion of the IFDP is the NNSA Y-12 Site Office. Stakeholder interests are primarily associated with continuity of operations during all phases of the IFDP. With regard to this phase, the preferred strategy significantly limits the potential for interruption of utility service to critical processes associated with ongoing Y-12 mission activities. Y-12 Site Office staff contacted with regard to this phase concurred that their interests have been effectively considered by the preferred strategy for site reconfiguration in support of the IFDP at Y-12.

#### 3.4.2.4 SAFETY, SECURITY, PROGRAMMATIC ISSUES

The preferred strategy involves parallel construction of utility services around targeted IFDP facilities. As mentioned above, this strategy limits worker exposure to energized electrical lines and charged air, water, and steam lines while buildings are being isolated in preparation for demolition. Further, complete isolation of the facilities will support the application of a more fully mechanized method of building demolition that will contribute to workplace safety and efficiency.

Continuity of alarm and security services will be maintained throughout the utility relocation project by constructing and hot tapping parallel lines of service prior to disconnecting the targeted facility. All identified issues associated with maintenance of security services have been addressed in the CD-1 documentation.

Programmatic issues are primarily associated with maintenance of utility service to critical ongoing mission activities while IFDP activities are underway. The preferred alternative adequately addresses these concerns.

# 4.0 ETR TEAM CONCLUSIONS/RECOMMENDATIONS

The table below summarizes the issues identified by the ETR Team, recommendations for addressing the issues, and an observation category for the issue/recommendation combination. Although there are a number of identified issues, overall the ETR Team concluded there were no severe technical issues that would need to be resolved prior to continued programmatic consideration of the IFDP. With respect to the primary risk factors reviewed, the ETR Team concludes with reasonable confidence that the technical approaches planned to remediate contamination and to carry out the reconfiguration of facilities can be done safely and effectively, and consistent with environmental stewardship.

| Mercury Issues | Recommendation | Category |
|---|---|---|
| | OVERARCHING ISSUES | |
| • IFDP integrates the efforts of multiple DOE landlords to achieve significant progress on the shared goal of mercury remediation. | Continue this practice. | Good Practice |
| • The benefits and objectives for mercury remediation activities lack specificity and clarity. | Clear, measurable and achievable goals for mercury remediation should be developed in support of design activities and guide future activities. | Technical Issue & Opportunity for Improvement |
| • IFDP alone will not “get rid of environmental liabilities” as stated in the CD-1 documentation, and there is not a direct linkage between mercury source reduction and emerging stream protection endpoints such as fish tissue concentrations. However, mercury source reduction is a key component of the two primary regulatory drivers currently addressing mercury remediation. | Work with regulators & other stakeholders to develop a realistic environmental management strategy and associated permits/commitments that reduce mercury impacts to levels that are as low as reasonably achievable. Critical first steps toward this effort are to move ahead expeditiously with the CERCLA mandated work as well as to integrate IFDP and other source mitigation activities with other actions to maximize environmental benefit and regulatory responsiveness, and minimize costs, energy use, and adverse collateral impacts. | Technical Issue & Opportunity for Improvement |
| | ALTERNATIVES EVALUATION | |
| • The conceptual design provides little information and focus on the process and pathway to implement the selected case-by-case alternative for remediation of mercury contaminated soil and debris. | Develop metrics on “how” decisions will be made during implementation of a case-by-case application of technologies. The technical basis and defensibility of the technology selection/design and waste characterization & segregation processes should be a primary focus of CD-2. | Technical Issue |
| • The basis for assumed quantities of contaminated vs. uncontaminated debris should be clarified and documented. | Define and document a clear basis for assumptions and accurate estimates of quantities of contaminated debris in order to better support technical feasibility, cost, and scheduling estimates. | Technical Issue |
| • The metrics and technologies for characterizing and segregating contaminated from uncontaminated mercury soil and debris were not provided. | Clarify, document and implement technically-based methods to characterize and segregate contaminated soil and debris. | Technical Issue |

| Mercury Issues | Recommendation | Category |
|---|---|---|
| TECHNICAL FEASIBILITY & EFFECTIVENESS | | |
| • Regardless of the screening criteria for pretreatment of soils, there is insufficient data for allocating the soils requiring treatment. . | Improve estimates of soil volumes requiring treatment should be refined and clearly documented. Expedite collection of sub-slab characterization data (e.g., using techniques such as field screening, horizontal borings, sub-slab penetrations, etc.), and other characterization. | Opportunity for Improvement |
| • The approaches used for assessing the need for and adequacy of treatment may not mimic field conditions. | Enter into discussions with EPA on use and approval of an alternative performance-based approach for waste characterization, treatment development and effectiveness documentation, and support of performance scenario performance assessment. | Technical Issue |
| • There is no substantive plan for recycling in the CD-1 document. | Recycling opportunities, both within the DOE complex and in commerce, should be considered as appropriate. | Opportunity for Improvement |
| • The base case for a portion of the mercury contaminated debris from Alpha 4 assumes treatment by low temperature thermal desorption (consistent with CERCLA ROD commitments). | Integrate disposition of this debris with other similar debris (e.g., Alpha 2, bulk of Alpha 4, Alpha 5 and Beta 4) and eliminate separate and costly treatment. Presume macro encapsulation of Alpha 4 debris to provide consistent environmental protection and handling. | Opportunity for Improvement |
| REGULATORY & STAKEHOLDER ACCEPTANCE | | |
| • Delay with respect to the implementation of CERCLA remedial actions could result in the IFDP project to be impacted by additional project risk. | In order to stay on the CERCLA track, it is important to proceed with commitments for remedial action in a disciplined but expeditious manner. Completing CERCLA activities in the short term (for example, moving to D&D buildings) could have two benefits: (1) demonstration of progress with respect to moving ahead with CERCLA and, (2) allowance for evaluation of the actual extent and magnitude of mercury contamination beneath these structures and remediation to proceed as appropriate. | Technical Issue& Opportunity for Improvement |
| • The extended time frame for finalization of remaining RODs increases uncertainty in implementing remedial actions. | Accelerate the schedule for finalizing the remaining RODs (particularly groundwater). The two existing RODs are interim in status, and the groundwater ROD is currently scheduled for completion in 2035. Begin a core-team process of defining the long-term remediation goals and have these goals reflected in final RODs earlier than currently scheduled. | Technical Issue |

| Mercury Issues | Recommendation | Category |
|---|---|---|
| • The location of ultimate IFDP soil and debris disposition remains uncertain until more detailed soil and debris characterization and more accurate waste volume estimates are available. | a) Additional evaluation of potential waste characteristics when developing CD2/3.<br>b) The new disposal cell be designed and operated to provide a high degree of environmental protection, and the team recommends development of waste acceptance criteria that focus on maximizing the portion of the IFDP waste acceptable for safe on-site disposition. | Technical Issue |
| • Overlap of NPDES on CERCLA remedial actions could present challenges or opportunities. | Aggressively pursue the CERCLA remedial actions while optimizing the integration of NPDES and CERCLA regulatory framework | Good Practice |
| • Regulator and stakeholder support will be critical in achieving IFDP success. | The Environmental Program Council and the Core Team process should be supported and continued. Continue working relationship with external stakeholders including both individual community members, community groups and other organizations (Site Specific Advisory Board, Environmental Quality Board, etc.). Such stakeholder support will be critical for achieving IFDP success, specifically in the area of on-site disposal of mercury-contaminated waste. | Good Practice |
| | **SAFETY & SECURITY RISK** | |
| • The CD-1 does not document the impact of increased security requirements on cleanup performance. | Include in the quantification of impacts due to increased security requirements, the corresponding cost and schedule impacts on the IFDP Project during the CD-2/3 process. | Area of Concern |
| • Opportunities for effectively providing necessary security while minimizing negative impacts on schedule have not been sufficiently evaluated. | The Transition Team should designate an individual with the mission and authority to facilitate the ingress and egress of remediation and demolition personnel. | Opportunity for Improvement |
| | **PROGRAMMATIC AND RISK EVALUATION** | |
| • The assumptions used in some of the high risks appear to significantly underestimate the technical scope, cost, and schedule impacts of the most likely and worst case scenarios. | For Risks R-0004, 0012, and 0015, expand the worst case impact to not artificially truncate. For Risk R-0004, add a worst case schedule impact as this will likely be in the critical path if it occurs. For Risk R-0012, add more significant cost and schedule risk on the potential of a TMDL basis of 0.3 mg/kg. For Risk R-0015, for the worst case, assume more than 10% of the waste may have to be disposed offsite. Better assess the risk mitigating actions and add to the risk register. | Technical Issue |

| Mercury Issues | Recommendation | Category |
|---|---|---|
| • No risk is identified that evaluates losing NTS disposal capability for MLLW after December 2010 and timing of new on-site disposal capacity. | Develop a risk assessment form for the loss of MMLW disposal capability at NTS post December 2010. | Technical Issue |
| • The majority of the schedule risk appears to be attributed to the availability of money. | Schedule risk should incorporate technology uncertainties and other aspects of the project beyond availability of funding. | Technical Issue |
| • The direct-cost-to-contingency ratio for mercury remediation work appears skewed. For mercury remediation, the direct cost is estimated at $180M while contingencies total $434M. This presents a programmatic risk in ability to execute the defined mercury scope at the assigned direct cost. | Reallocate the cost distribution for mercury remediation and balance the distribution between direct cost and contingency up to a level consistent with the CD-1 estimation. | Technical Issue |
| • The rankings in the risk register may not have been applied consistently. | Consider adjusting the ranking of R-0008 and R-0010 to a moderate risk to more closely align to similar risks. | Opportunity for Improvement |
| • It is not clear that all the predecessor characterization activities and data compilation steps are factored into the plan for the first 5 years to ensure the ROD date is met. | In the CD-1 Preliminary Project Execution Plan modify sections 3.5.5.1 and 3.5.5.2-ORNL and Y-12 Phase A Plan (FY2010-2014) to ensure that priority gets placed on the predecessor tasks, such as facility and media characterization and data compilation, and there are solid logic ties to support the EMWMF ROD change for the decision to expand the EMWMF by 2014. | Technical Issue |

| Facility Reconfiguration Issues | Recommendation | Category |
|---|---|---|
| | **OVERARCHING ISSUE** | |
| • The justification and timing for the D&D of the existing facilities needed for the landlord mission (e.g. 3525 and 3025E at ORNL) and the capability and flexibility needed in the replacement facility was not clear to the ETR. | During CD-2, more information on the Department's need for maintaining the mission capabilities at ORNL and Y-12, what the expected future utilization will be, and the duration of the expected future mission needs for that research capability should be fully explored and documented. Further, the Integrated Facilities Disposition Project Team should clearly identify factors (e.g., are there alternatives to maintaining 3525 and 3025C as active facilities and still meet the requirements of IFDP remedial actions) that affect the decisions relating to the nuclear facilities that would be relocated from Bethel Valley to Melton Valley. | Opportunity for Improvement |
| | **SOLID & LIQUID WASTE FACILITIES** | |
| • The CD-1 documentation did not identify the trenchless technology as a possible alternative at either ORNL or Y-12, although both sites have many existing pipelines in and through contaminated areas. | During CD-2, the IFDP team should consider (and should document the evaluation) for use of technologies for working in and around contaminated sites such as ORNL and Y-12. Specifically, the technology for installing pipes in existing underground pipes should be explored as part of the alternatives evaluation and the results of those evaluations clearly documented. | Technical Issue |
| • The evaluation of alternatives for handling and processing both RH solids and low level liquid waste (LLLW) systems did not appear to adequately assess all the capability available to ORNL. | a) During the CD-2 phase, a comprehensive evaluation of handling and processing RH solid waste alternatives including modifying the Transuranic Waste Processing Center (TWPC) should be complete.<br>b) During the CD-2 phase, a comprehensive evaluation of handling and processing RH solid waste alternatives including modifying the Transuranic Waste Processing Center (TWPC) should be complete.<br>c) During the CD-2 phase, a RH Waste Focus Team needs to evaluate handling and disposition for difficult to process waste. Any difficult waste that will require the use of an ORNL facility list should be scheduled and completed before the facility D&D.<br>d) The IFDP team needs to evaluate the feasibility of modifying the TWPC to provide long-term LLLW treatment capability as an alternative to the Melton Valley Nuclear Fuel Center LLLW treatment system.<br>e) The IFDP team needs to carefully review the D&D schedules | Technical Issue |

| Facility Reconfiguration Issues | Recommendation | Category |
|---|---|---|
| | shown in the CD-1 and determine if LLLW treatment capability will be available when needed. | |
| • The IFDP team expressed significant concern about safety basis requirements as they relate to modification of facilities. These concerns may have biased analyses results in favor of new facilities in lieu of modifying existing facilities such as the TWPC . | The IFDP team needs to ensure that the utilization of the TWPC has been completely evaluated from a nuclear safety perspective. | Technical Issue |
| • The evaluation of alternatives for the process wastewater and groundwater reconfiguration of ORNL made an assumption that conventional, doubly-contained steel piping would be required to connect process water treatment capabilities in Bethel and Melton Valleys. | The alternatives for these wastes need to be re-evaluated reflecting the estimated cost of alternative such as trenchless piping referenced in Section 3.1. | Technical Issue |
| • Utility reconfiguration planning at Y-12 in support of the IFDP relies on reconstruction of existing system connections to bypass buildings targeted for demolition in the IFDP. The IFDP Team indicated that little effort was invested in determining the most efficient means of isolating | The IFDP Team should incorporate value engineering assessments into CD-2 efforts to ensure cost effective and efficient utility reconfiguration on a facility by facility basis. For example, analyses should determine whether to re-route cooling water lines or install facility specific chillers; re-route compressed air or install a single or multiple stand alone units. | Technical Issue |

# FIGURES

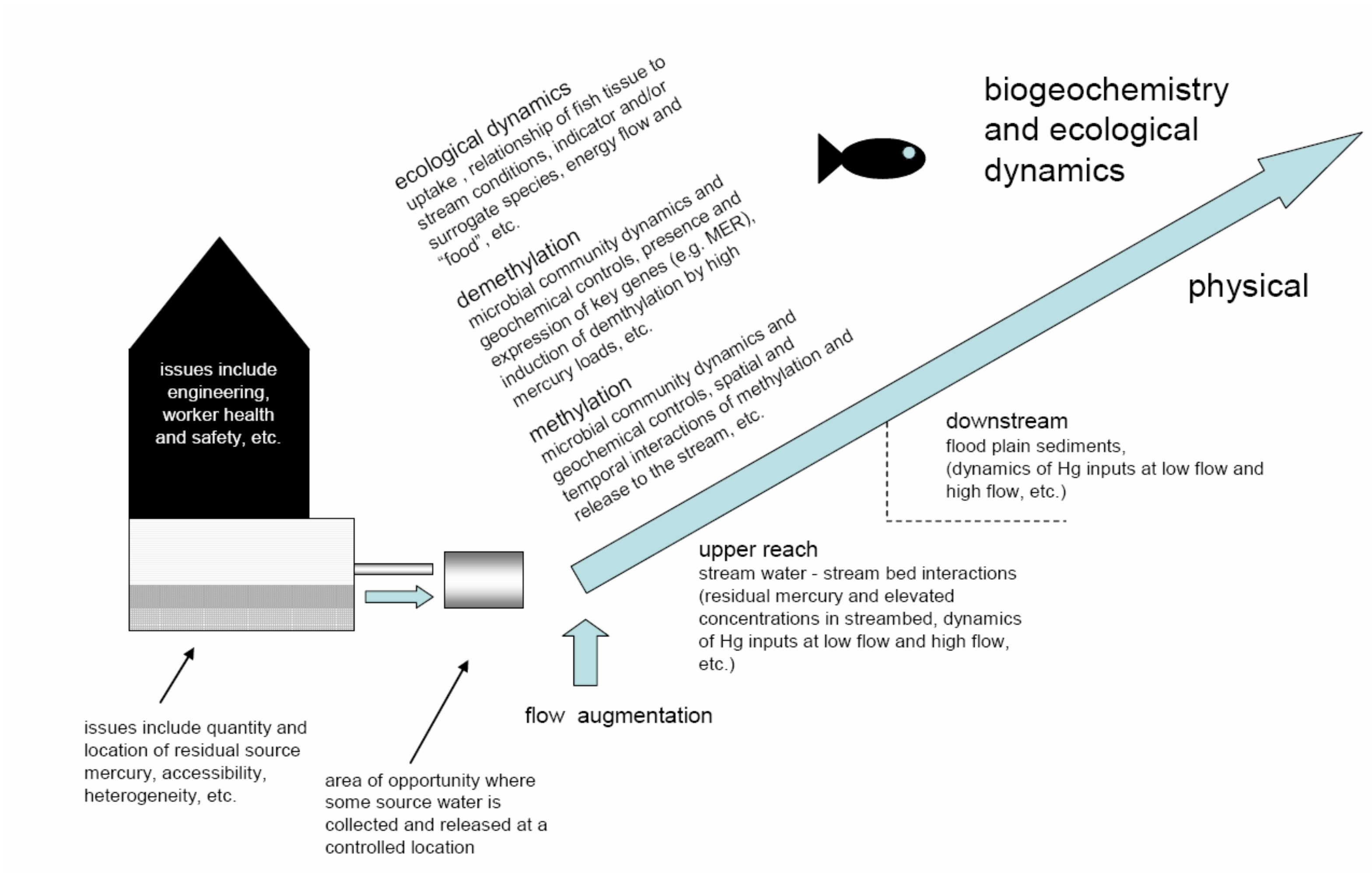


Figure 2-1. Summary depiction of site-specific mercury conditions In the East Fork Poplar Creek watershed, Oak Ridge

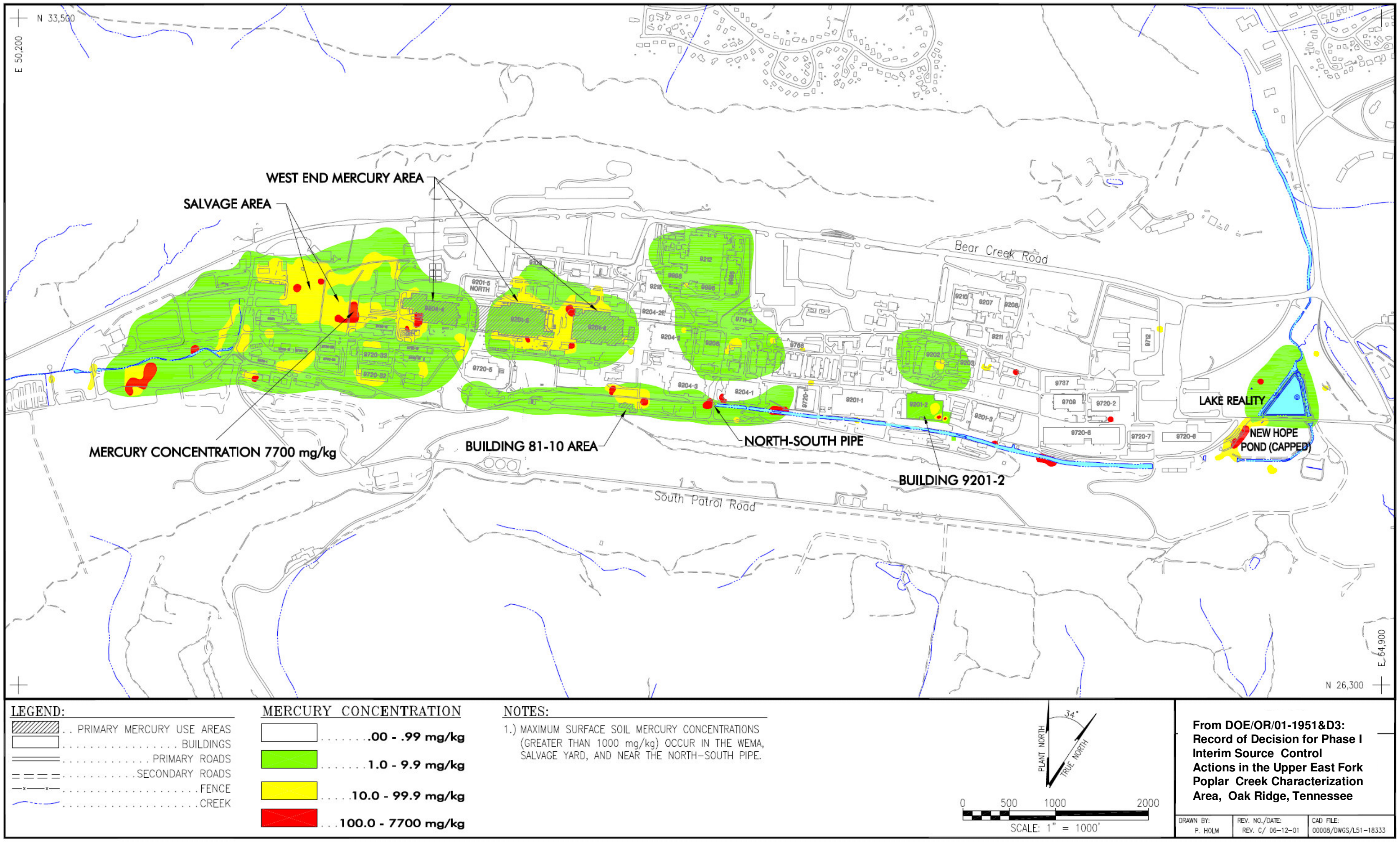


Figure 2-2. Mercury use areas and mercury soil concentrations at Y-12
(Figure obtained from Phase I & II ROD documents)

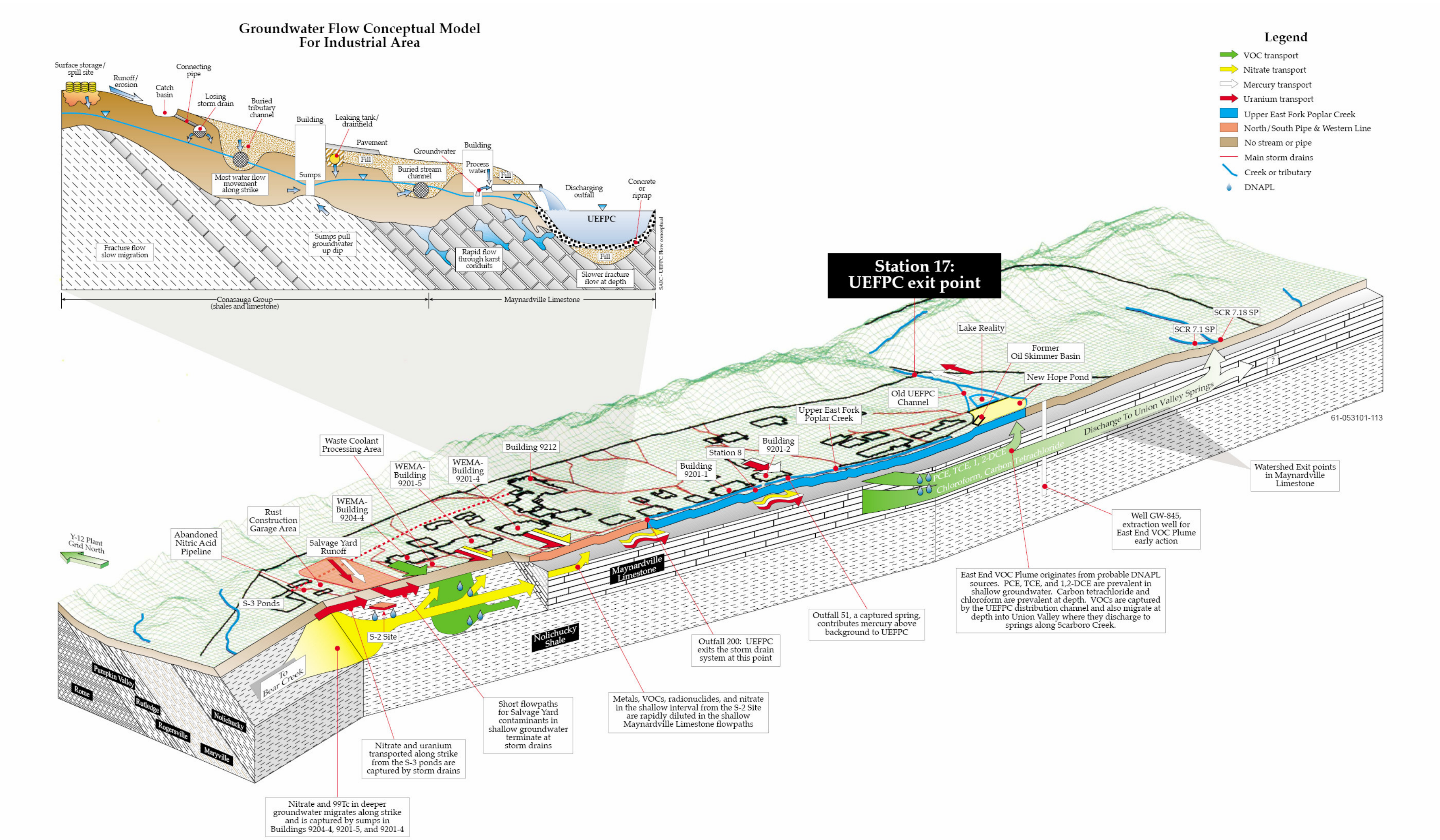


Figure 2-3. Generalized structure of UEFPC watershed and Y-12 facilities
(Figure obtained from Phase I & II ROD documents)

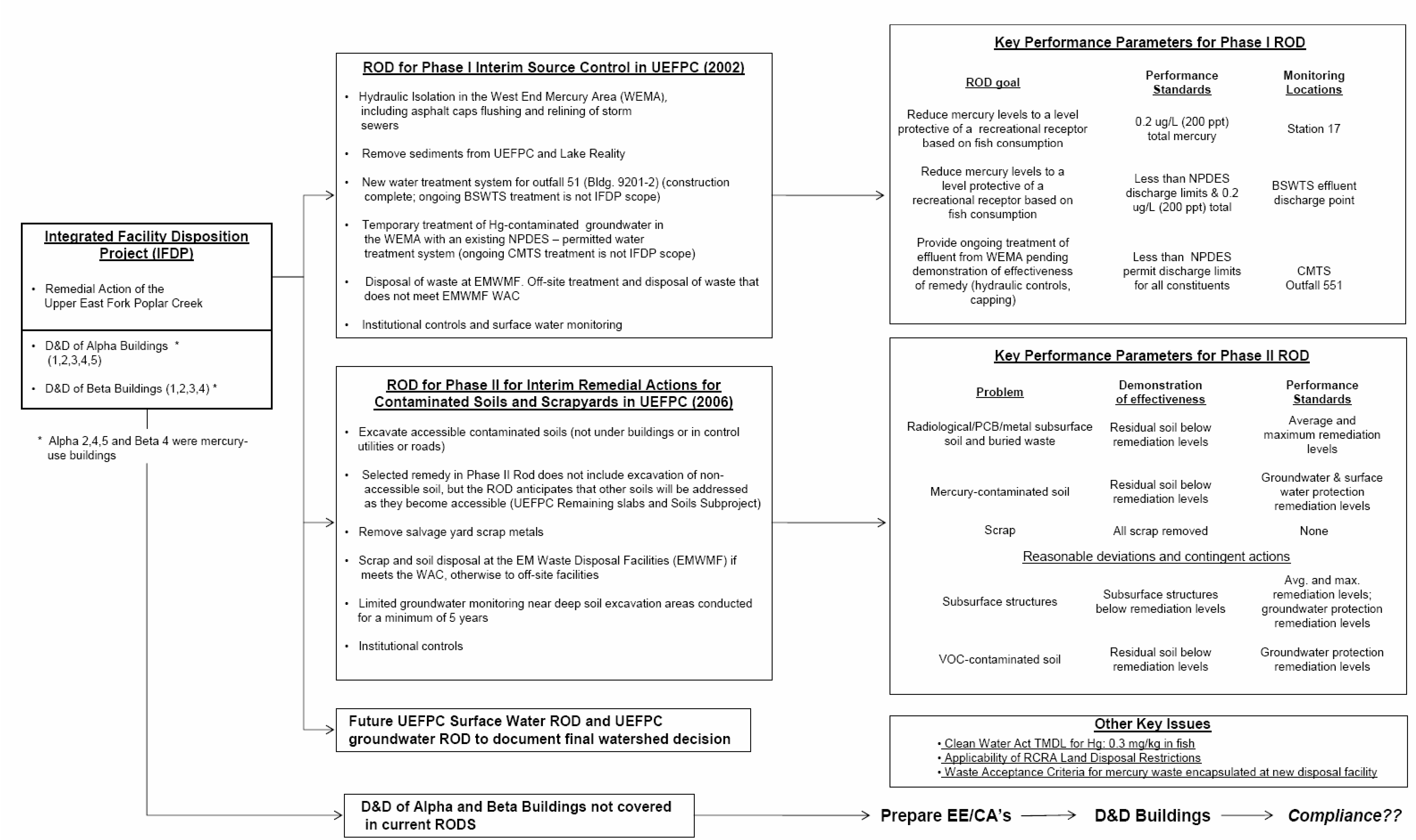


Figure 2-4. Regulatory Overview for Mercury Contaminated Debris and Soils from Y-12 Source Areas targeted by the IFDP

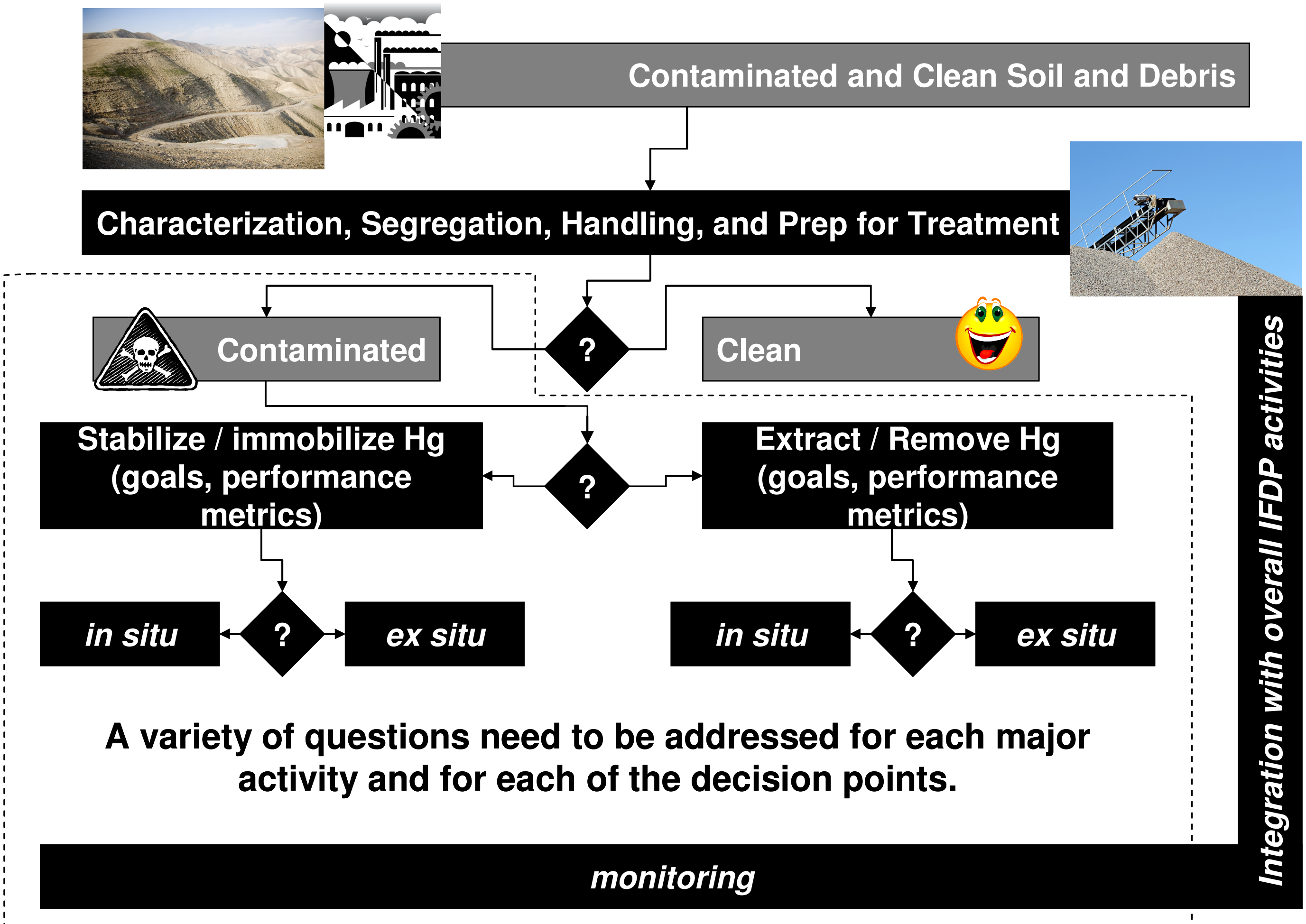


Figure 2-5. General schematic of major activities in the IFDP that are related to mercury contaminated soil and debris; note that the CD-1 efforts have focused primarily on the areas within the dashed boundary and additional efforts will be needed in CD-2/3 to define a more complete and integrated solution

**Technologies to Solidify / Stabilize / Immobilize Hg**

*Summary* -- "Solidification and stabilization (S/S) is used to treat elemental mercury and mercury-contaminated soil and sludge. This technology has been implemented at full scale and pilot scale. S/S reduces the mobility of contaminants in the media by physically binding them within a stabilized mass or inducing chemical reactions." (EPA 2007). OR has identified a form of stabilization, (macro)encapsulation, as a preferred alternative.

*Technology Description*: S/S reduces the mobility of mercury and other contaminants in the environment by altering physical and/or chemical conditions. Contaminants can be physically bound or enclosed within a stabilized mass or the contaminant can be converted into less soluble, less mobile, or less toxic forms. Amalgamation is one approach used to immobilize elemental mercury by dissolving the mercury in another metal to form a semisolid alloy known as an amalgam. The process is a physical immobilization and is often combined with encapsulation to prevent volatilization of mercury from the amalgam. Media Treated: Soil, Sludge, Other solids, Liquid wastes, Industrial waste, Elemental (liquid) mercury.

*One (or a combination of) the following materials have been documented for S / S of Hg:*

- Cement
- Calcium polysulfide
- Chemically bonded phosphate ceramics (CBPC)
- Phosphate
- Platinum
- Polyester resins
- Polymer beads
- Polysiloxane compounds (silicon hydride and silicon hydroxide)
- pH adjustment agents
- Sodium dithiocarbamate
- Sodium metasilicate
- Sodium sulfide
- Sulfur polymer cement (SPC)
- Copper (amalgamation)
- Tin (amalgamation)
- Nickel (amalgamation)
- Zinc (amalgamation)

*Typical questions from the EPA report related to selection of S/S technologies:*

General factors: • mercury oxidation state and form, • amount of mercury in waste, • other geochemistry (pH, redox potential, chloride, etc.), • waste characteristics (particle size matrix, etc.), • handling and mixing, • moisture content, • scale.

Figure 2-6. Sample of information in the EPA (2007) report on mercury treatment technologies

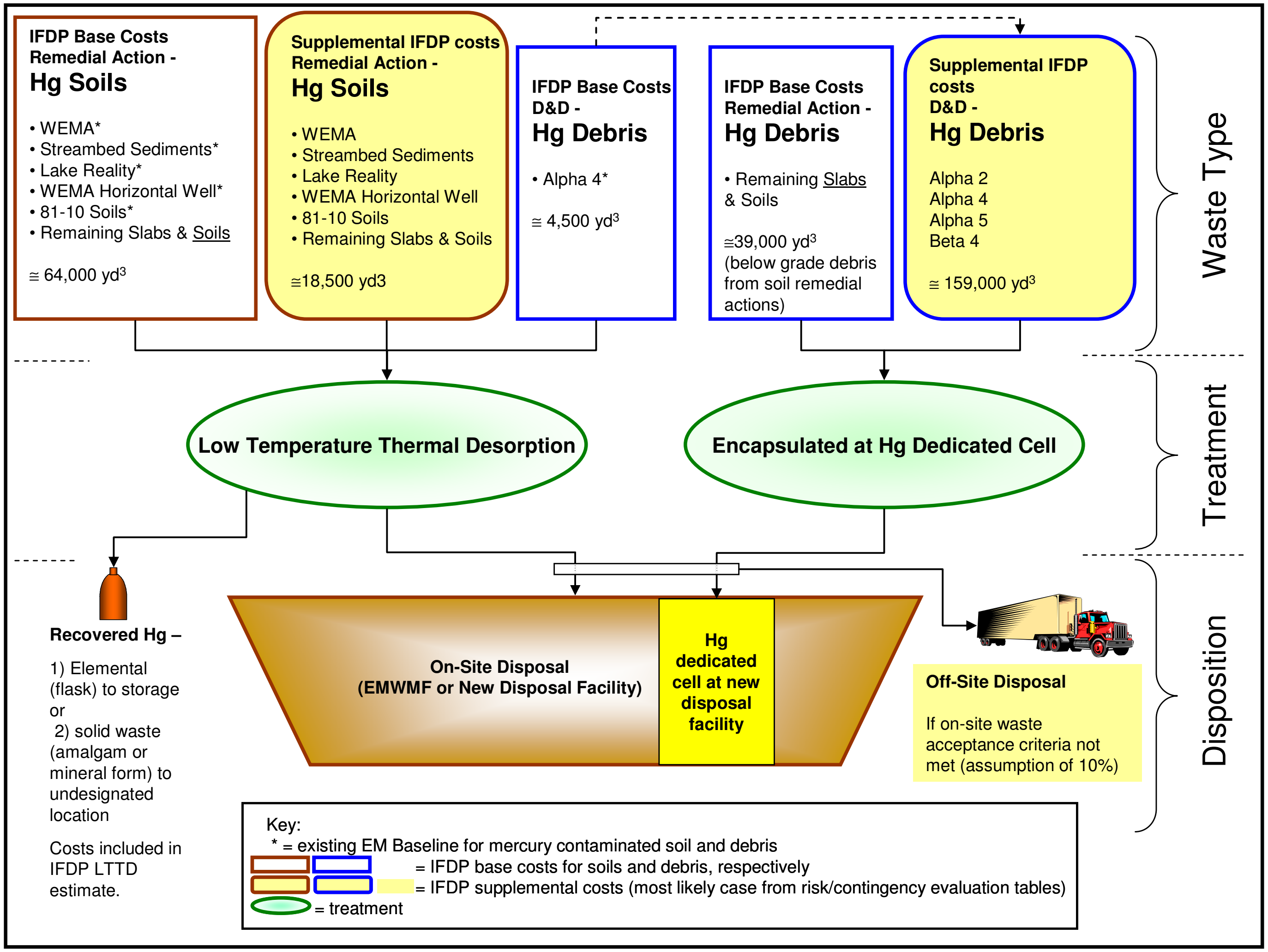


Figure 2-7. Summary of the mercury contaminated wastes, treatments, and dispositions for the IFDP

# APPENDIX A

## External Techical Review Charter

## Major Risk Factors
## Integrated Facilities Disposition Project

U.S. Department of Energy

Office of Environmental Management (EM)

Engineering and Technology

# External Technical Review (ETR)
# CHARTER

## Major Risk Factors
## Integrated Facility Disposition Project (IFDP)
## Oak Ridge, TN

June 2008

# External Technical Review (ETR)

**C H A R T E R**

## Major Risk Factors
## Integrated Facility Disposition Project (IFDP)
## Oak Ridge, TN

**BACKGROUND**

The DOE Oak Ridge Office (ORO) and the Office of Engineering and Technology (EM-20) are sponsoring an External Technical Review (ETR) related to the major risk factors of the planned Integrated Facility Disposition Project (IFDP), in Oak Ridge, TN.

The mission of the IFDP is to remediate legacy contamination at Oak Ridge National Laboratory (ORNL) and the Y-12 National Security Complex (Y-12) at the Oak Ridge Reservation (ORR). The scope of the IFDP is broad, including: facility reconfiguration; regulatory issues and compliance; Deactivation and Decommissioning (D&D) (i.e., characterization, deactivation, decommissioning, decontamination, demolition, waste management, and disposition of excess facilities and equipment); remediation of contaminated soil, groundwater, and surface water; and disposition of legacy materials, as well as landfill closure. The IFDP will be conducted under the Comprehensive Environmental Response Compensation, and Liability Act, and a Federal Facility Compliance Agreement.

Approximately two million pounds of mercury are unaccounted for at Y-12, and potentially resulting in contamination of soil and groundwater. The greatest risk/liability to DOE and the public is mercury getting into the surface water (East Fork Poplar Creek) which flows off the federal reservation through private property to waters of the State of Tennessee, and taken up by fish, plants, and other animal life. DOE, regulators, and the public need to have reasonable confidence in the technologies and technical approaches used to remediate this contamination in regards to safety, effectiveness, and environmental stewardship and sustainability.

ORO identified the highest cost and risk factors for IFDP execution as (1) Treatment and Disposal of large quantities of Mercury Contaminated Soil and Debris, and (2) the technical approach related to Facility Reconfiguration for radioactive waste and low level liquid waste (LLLW) management.

EM recently completed a technical assistance report on "Recommendations to Address Technical Uncertainties in the Mitigation and Remediation of Mercury Contamination at the Y-12 Plant, Oak Ridge, Tennessee." The report provides relevant information on mercury pathways, mechanisms, processes, and remediation strategies for groundwater and soil remediation.

The IFDP facility reconfiguration scope includes characterization, treatment, packaging, and disposal of waste streams for which no treatment capability and capacity exists on site.

Remote-Handled (RH) solids process requirements include:

(a) Extremely high activity/high dose rate (>$10^6$ R/hr) materials;
(b) Very large (≤ 40 T) high to moderate dose rate materials and large and high dose rate D&D wastes; and
(c) Materials examination and characterization capability.

This waste cannot be shipped off-site in its current state because of transportation requirements for pre-treatment and packaging in certified containers; further, it does not meet waste acceptance criteria of any disposal site. The remaining options are to:

(a) Build specially-designed storage casks, based on physical dimensions and level of activity, and create a new facility for indefinite on-site storage;
(b) Modify current on-site treatment facilities; or
(c) Build a new treatment facility.

The IFDP requires processing and treatment of LLLW for disposal. The current LLLW system at ORNL is oversized (< 1% of current capacity is required for future operations), and is reaching the end of its design life. Remediation of soils and groundwater requires removal of existing LLLW facilities. Options include:

(a) Continuing to operate the current antiquated LLLW system, with annual operation and maintenance costs in the tens of millions of dollars, and risk catastrophic failure.
(b) Building a new right-sized LLLW system and consider alternative methods to remediate contaminated soils and groundwater near the existing facilities.

The ETR process is intended to reduce programmatic risk and increase confidence in technical approaches for future key decisions. It is described in Standard Operating Policies and Procedures (SOPP) No. 26, External Technical Reviews for the Environmental Management (EM) Program.

The goal of this ETR is to reduce technical risk and uncertainty associated with mercury remediation and facility reconfiguration. Subsequent external reviews are envisioned to address other primary drivers.

## SCOPE OF REVIEW

The ETR will review the risk and strategies to address the major risk factors indentified by ORO during preliminary planning for the IFDP, namely:

- **Treatment and Disposal of Mercury Contaminated Soil and Debris**
- **Facility Reconfiguration** (e.g., facilities for radioactive waste processing, such as for RH solids and LLLW)
- **Other major risk factors** as may be identified and mutually agreed to

The ETR focuses on technical issues associated with the remediation of large quantities of mercury-contaminated soil, and an assessment of risks and schedule impacts of alternatives for processing RH solids and LLLW.

## TEAM MEMBERSHIP

ETR teams include distinguished experts on topics in the scope of review, and that collectively provide a reasonable measure of independence from the project being reviewed, and the ability to address emerging issues.

The ETR Team Lead is **Ms. Yvette T. Collazo**, Director, Office of D&D and Facility Engineering (EM-23). **Dr. Vincent Adams**, Director, Office of Groundwater and Soil Remediation (EM-22), is Deputy Team Lead. The management team is completed by a Technical Lead† that is supported by topical leads. ††

The preliminary list of prospective team members includes:

**Dr. T.J. Abraham,** MSE-TA
**Dr. James Clarke,** CRESP
**Mr. Charles Fellhauer**, Consultant
**Dr. Andrew Garrabrants**, CRESP
**Dr. Peter Jaffee,** Princeton University
**Dr. Lynn E. Katz,** Univ. of Texas (Austin) †† [Mercury Contamination]
**Dr. Bryan Looney,** SRNL
**Ms. Julie Mathiesen, Consultant**
**Mr. Richard Meehan**, USDOE/NNSA
**Dr. Frank Parker**, Vanderbilt University †† [Facility Reconfiguration]
**Dr. J. Winston Porter,** Waste Policy Center
**Mr. Richard Provencher,** USDOE/NE
**Dr. William Shutte**, Consultant
**Dr. Anibal L. Taboas,** Consultant † [Technical Lead]
**Mr. Doug Turner**, Visionary Solutions, LLC
**… and others to be determined.**

The ETR Lead has full authority and responsibility for all aspects of the review, including, but not limited to, team composition, purpose, roles and responsibilities, expected outcomes, and issue resolution. The Deputy Team Lead will coordinate the completeness of background information for review by ERT members, the appropriateness and timeliness of information requests, and drive report completion. Site liaison will be provided by **Ms. Elisabeth C. Phillips** and **Mr. Ralph M. Skinner** (ORO).

Expectations of the ETR Team Lead include effective control of the team, process, schedule, and content. Expectations for ORO include providing timely and complete background documentation, briefings to ETR Team Members, support of ETR site visit(s), and responses to information requests.

## PERIOD of PERFORMANCE

The ETR will be conducted in an accelerated pace to support delivery of a draft report by mid August 2008.

- ORO has compiled a comprehensive document package for review by ETR team members, which will be augmented by other relevant sources as may be requested by the team. To the extent practicable, the documentation will be available in electronic form via the World Wide Web at ftp://ftp.p2s.com.

- By June 6, the Team Lead will complete administrative and logistical aspects (including selection of team members and designation of sub-leads), and establishing contact with team members
- By June 13, the site liaison will assure completion of contractual arrangements as required for individual reviewers, access authorization, funding, and logistics
- In June, representative ETR lead members will conduct a two day preliminary on-site visit
- By June 17, the Team Lead will host a preliminary meeting of the overall management team, in Forestall, including status briefings from project staff and site liaison, and follow-up on action items
- By June 30, the Team Lead will
  - hold a teleconference with the entire ETR team
  - advise EM-20 and the ORO Manager on the status of overall planning, including issues, if any, to execution
  - finalize the schedule for document review, on-site visits, and briefings, and discussion with and among the team members
- In July,
  - the ETR Team will perform an extensive on-site review (circa July 15-25)
  - the Team Lead will issue draft findings to site liaison, and allow for 2-3 days of factual accuracy review
- In August, the Team Lead will provide a draft report to the ORO Federal Project Director, and brief EM-20 and the ORO Manager on the team's findings.

**LINE of INQUIRY**

Lines of inquiry are intended to focus effort and achieve the scope of the review. The Team is encouraged to rigorously evaluate and modify the following representative lines of inquiry, to hone in as to the appropriate intent of the review, and to restate and document the approach used, as part of the final report.

- **Treatment and Disposal of large quantities of Mercury Contaminated Soil, and Debris**
  - Have the alternatives for characterization, treatment and disposition of mercury contaminated soil and debris, been appropriately evaluated and documented? Are these alternatives feasible and likely to be accepted by the regulators and stakeholders as meeting cleanup objectives?
  - Have the alternatives for characterizing, fixing-in-place, or removing contaminated equipment and piping been appropriately evaluated and documented? Are these alternatives feasible and likely to be accepted by the regulators and stakeholders?
  - Have the safety, security, technical, and programmatic risks associated with these alternatives been appropriately evaluated and documented?
  - Are there additional alternative approaches/strategies that should be considered?

- **Facility Reconfiguration (e.g.: facilities for radioactive waste processing, such as for RH solids and LLLW)**
    - Have the alternatives for characterizing, treating, packaging, and disposing of waste from IFDP D&D operations been thoroughly evaluated and documented as to meeting cleanup objectives?
    - Have the safety, security, technical, and programmatic risks associated with these alternatives been fully and properly considered?
    - Are there additional approaches/strategies that should be considered?

**APPROVALS**

J. T. Howell

**J.T Howell**, Federal Project Director
Integrated Facility Disposition Project, ORO

Yvette T. Collazo

**Yvette T. Collazo**, Director
Office of D&D and Facility Engineering (EM-23)

Gerald Boyd

**Gerald Boyd**, Manager
Oak Ridge Office
Office of Science

**Mark Gilbertson**, Deputy Assistant Secretary
for Engineering and Technology (EM-20)
Office of Environmental Management

June 2008

# APPENDIX B

## Reference Documents

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* Documents were developed in response to ETR Team request for additional information and are available for viewing at ftp://ftp.p2s.com.

** Written summaries of personal communications are available for viewing at ftp://ftp.p2s.com

# APPENDIX C

## External Technical Review Team – Member Biographies

# APPENDIX C

## External Technical Review Team – Member Biographies

**TJ Abraham** brings over 20 yr of experience in Energy and Defense programs, with particular expertise in waste management, environmental restoration, the Oak Ridge Reservation (ORR), and in the management, control, protection, and accountability (MC&A) of special nuclear materials. Dr. Abraham was responsible for the technical approach to design and selection of technology for a mixed waste treatment and storage facility at the East Tennessee Technology Park, and negotiated the licensing of mercury and PCB treatment technologies (including stabilization and vacuum thermal desorption). He has also led the development of treatment approaches for mixed wastes at ORR in support of a Federal Facilities Compliance Program, and managed R&D on mixed waste treatment technologies, and various remediation projects at the Oak Ridge National Laboratory (including low level liquid waste, tanks, and grouting). Dr. Abraham has also been intimately involved in project management (e.g.: the Fernald Silo Waste Retrieval System test loop, strategic planning, performance assessments, and waste certification), and MC&A programs involving domestic and foreign sites. Dr. Abraham earned his BS, MS, and PhD in Chemical Engineering (Univ. of Tennessee). Dr. Abraham serves in the ETR Facility Reconfiguration Team, and can be reached via electronic mail at: **TJ.Abraham@mse-ta.com**.

**Vincent Adams** directs the Office of Groundwater and Soil Remediation in the Environmental Management program of the US Department of Energy. He has ~30 yr of experience in environmental, groundwater, homeland security, and health & safety, in public, and private sectors, as well as academia. During the past 21 years with DOE, Dr. Adams has managed and directed several major and highly visible programs and projects at Oak Ridge, including a $360M Melton Valley cleanup project; the $400M+ Three-Building D&D project; development of the K-25 environmental management program after shutdown of uranium enrichment; startup and operation of the OR Mixed Waste Incinerator; stand up and operation of the EM Facility Representative program (including qualification to oversee nuclear & hazardous facilities); and stand up and operation of the national centers of Excellence for Metals & Materials Recycling. Vince led in establishing the groundwater program for the Office of Civilian Radioactive Waste Management project at the Texas site. Dr. Adams has the unique distinction of having both in-depth experience and specialized degrees in all three media (water, air and soil) of contaminant transport and behavior. Vince has extensive academic training and experience in the development and application of environmental fate transport and risk models, including air dispersion and groundwater models. Dr. Adams received a BS in Civil & Public Health Engineering (Guyana), MS in Geological Engineering (Univ. of Missouri), M.S. in Groundwater Hydrology (Ohio), and PhD in Environmental Engineering (Univ. of Tennessee). Dr. Adams serves as Deputy Lead of the overall ETR, and can be reached via electronic mail at: **Vincent.Adams@em.doe.gov**.

**James H. Clarke** is Professor of the Practice of Civil & Environmental Engineering, Professor of Earth & Environmental Sciences and Director of Graduate Studies in Environmental Engineering at Vanderbilt University. His research interests include assessment of the risks and environmental impacts of conventional and emerging energy approaches, risk-informed regulation and the restoration and long term management of legacy chemical and radioactive waste sites. Prior to joining Vanderbilt University, Jim spent 25 years in private practice leading a nationally known consulting and engineering firm specializing in the investigation and remediation of contaminated sites, risk analysis and industrial wastewater treatment. Dr. Clarke is a consultant to the Nuclear Regulatory Commission (NRC) Advisory Committee on Reactor Safeguards and a former member of their Advisory Committee on Nuclear Wastes and Materials. He provides consulting and expert witness services to the private sector and government and serves as a peer reviewer for the USDOE, NRC, U.S. Environmental Protection Agency, the National

Academies, and several journals and book publishers. Dr. Clarke received a BA in Chemistry with honors (Rockford College) and a PhD in Theoretical Chemistry (The Johns Hopkins University). Dr. Clarke serves in the ETR Mercury Issues Team, and can be reached via electronic mail at: **James.H.Clarke@vanderbilt.edu**.

**Yvette T. Collazo** directs the Office of D&D and Facility Engineering in the Environmental Management Program of the US Department of Energy. Yvette joined the federal career Senior Executive Service as Assistant Manager for Closure Project at Savannah River. In this capacity, she provided leadership and oversight direction to contractors, Federal programs and activities associated with the clean up of radiological, industrial and groundwater hazards resulting from nuclear materials production at the 310-square mile federal facility. Earlier, Ms. Collazo was Director of Program Support Services (Chicago Office), with responsibility for the Plutonium Disposition Program, Electricity Delivery and Energy Reliability, and construction grants. Yvette started federal service at the Argonne Area Office where she served various roles; including environmental compliance (managing application of RCRA, and assisting in CERCLA negotiations at the Brookhaven site), project management, and as team lead for environmental management. She's also led national programs involving independent peer review, use of best-available-science in rulemaking, risk management, and Hispanic employment. Yvette's accomplishments have been recognized by the Exceptional Service Award, the National Association of Hispanic Federal Executives Distinguished Public Service Award, Secretary of Energy Award for Achievement in Education, and various others. She also has several publications on decontamination and decommissioning, and the peer review process. Ms. Collazo has a BS in Mechanical Engineering (Univ. of Puerto Rico), an MS in Environmental Management and a Certificate of Environmental Studies (Illinois Institute of Technology). Ms. Collazo serves as the overall ETR Lead, and can be reached via electronic mail at: **Yvette.Collazo@hq.doe.gov**.

**Andrew Garrabrants** is Assistant Research Professor in the department of Civil and Environmental Engineering at Vanderbilt University. Dr. Garrabrants has 12 years of experience in development of leaching protocols, interpretation methodologies and assessment models, primarily for inorganic constituents in hazardous, radioactive and mixed waste systems. Other research interests include (i) release assessment approaches for semi-volatile organics, (ii), physiochemical models for estimating source terms for risk assessment and risk evaluation, and (iii) leaching chemistry and long-term durability of cement-based solidification/stabilization waste treatment and cementitious engineered barriers for nuclear waste disposition. He is actively involved with ASTM International D-34 Committee on Waste Management and leads a task group on Waste Leaching Techniques. Dr. Garrabrants is member of the American Institute of Chemical Engineers, American Society of Civil Engineers, and the Society for Risk Analysis. Dr. Garrabrants earned undergraduate and graduate degrees in Chemical and Biochemical Engineering from Rutgers. Dr. Garrabrants serves in the ETR Mercury Issues Team, and can be reached via electronic mail at **A.Garrabrants@vanderbilt.edu**.

**Lynn E. Katz** is Professor of Engineering, and John A. Focht Centennial Teaching Fellow in Civil Engineering, at the University of Texas in Austin. Dr. Katz's teaching interests include aquatic chemistry, surface and interfacial phenomena, physicochemical treatment processes for water and wastewater and biological wastewater treatment. Her research has focused on the fate and transport of contaminants in natural and engineered systems. Specific research interests include the physicochemical processes which control the rate and extent of partitioning of organic and inorganic contaminants to soils and sediments, evaluation of physicochemical and integrated biological/physicochemical processes for removal of contaminants from water and wastewater, and elucidation of reaction mechanisms at mineral/water interfaces. Her research has included the development of in-situ remediation and ex-situ treatment processes as well as the development and application of surface complexation models and distributed reactivity models for predicting contaminant adsorption to soils and clay minerals. Dr. Katz has significant publications, particularly in relation to contaminant fate and transport, combined abiotic/biotic treatment systems for in-situ remediation, and environmental surface chemistry. Dr. Katz's awards include an Outstanding Paper Award from *Water Research,* a National Science Foundation Career Award and the L. Hudson Matlock Teaching Award. She has been elected to the boards and to officer positions of the Association of Environmental Engineering and Science Professors (AEESP), the American Society of Engineering Education (ASEE), the American Chemical Society Division of Geochemistry, and the AEESP Foundation. Dr. Katz has a BS (The Johns Hopkins Univ.) and MS (Univ. of Michigan) in Environmental Engineering, an MS in Chemistry and a PhD in Environmental Engineering (Univ. of Michigan). Dr. Katz leads the ETR Mercury Issues Team, and can be reached via electronic mail at: **lynnkatz@mail.utexas.edu.**

**Brian B. Looney** is a senior fellow engineer at the Department of Energy's Savannah River National Laboratory (SRNL), and an adjunct professor in the Environmental Engineering Science Department at Clemson University. Brian coordinates development and deployment of innovative environmental characterization and clean-up methods at Savannah River, and advises the DOE Environmental Management Program. Dr. Looney developed, tested and deployed a wide range of environmental characterization and clean-up methods. Successful research includes uses of environmental horizontal drilling, and improved remediation (e.g., sparging, bioremediation, and thermal methods), and characterization tools (e.g., tracer testing, soil gas methods and geophysics). Currently, Brian coordinates technical activities to support source remediation and appropriate use of attenuation based remedies for organic contaminants, metals and radioactive contamination. Dr. Looney earned a BS degree in environmental science at Texas Christian University, and a PhD in Environmental Engineering from the University of Minnesota. He is an active member of the ITRC Enhanced Attenuation Chlorinated Organics Team, and has provided technical input to a number of organizations. He has received numerous awards and has authored and edited many publications including a book on *Vadose Zone Science and Technology Solutions*. Recent journal articles address geochemistry and remediation of mercury and other metals, and cleanup of chlorinated organics. Dr. Looney has nine patents for innovations in environmental technology. Dr. Looney serves in the ETR Facility Reconfiguration Team, and can be reached via electronic mail at: **Brian02.Looney@srnl.doe.gov**.

**Peter Maggiore** is Senior Vice President and environmental consultant with North Wind Inc. Peter has significant executive level significant experience in environmental management, hydrogeology and geology, and is a strong supporter of independent peer review. Mr. Maggiore has assisted a wide range of clients, including serving as senior advisor to the Environmental Management and the Civilian Radioactive Waste Management programs at the US Department of Energy, and serving in the Commission for Assessments and Reviews for the Institute for Regulatory Science. Mr. Maggiore served as Cabinet Secretary for the New Mexico Environment Department, and also served as Chairman of the Water Quality Control Commission, and as Vice-Chairman of the Mining Commission. In 1999, Mr. Maggiore signed the RCRA Part B Permit for the Waste Isolation Pilot Plant, which allowed the facility to start receiving "mixed TRU waste." Prior activities include hydrogeology and project management in relation to landfill investigations, permitting for mining operations, hydro-geological and geochemical studies, leaking underground storage tank site assessments and cleanups, long-term water supply evaluations, hazardous and medical waste treatment facility citing studies and environmental assessments. Mr. Maggiore was awarded the Dr. Dixy Lee Ray Memorial Medal by the American Society of Mechanical Engineers. Mr. Maggiore has an MS degree in Geology, and certification as Professional Geologist. Mr. Maggiore serves in the ETR Mercury Issues Team, and can be reached via electronic mail at: **PMaggiore@northwind-inc.com**.

**Julie Mathiesen** manages a wide range of environmental services as representative of Trihydro Corp., servicing primarily the oil and gas industry. Julie brings decades of experience in environmental compliance and project management, and highly effective management, leadership, communication, and analytical skills. Her background includes program development, environmental auditing, project review and assessment, site investigation and remediation, compliance investigations, permit preparation, natural resources management, and regulatory training. Ms. Mathiesen has been involved in various reactor removal projects (e.g., CVNPA-Parr, Big Rock Point, and ATSR), and consulting (Solid Waste Management, wetland quality assessments, developing wetland protection ordinances and strategic plans for regional watershed protection, oil/gas well installation, and NEPA review). Previously, Ms. Mathiesen served with distinction as Environmental Compliance Officer for Argonne National Laboratory - overseeing compliance with federal and state environmental regulations, and developing environmental policy. She also served as environmental regulator (RCRA and CERCLA) during her tour of duty at the US Environmental Protection Agency. In recognition of numerous process improvements, Ms. Mathiesen received the Department of Energy National Environmental Policy Act Compliance Officer Quality Award. Ms. Mathiesen has a BS in Biology and Environmental Science (Augustana College) and an MS in Environmental Engineering (Illinois Institute of Technology). Ms. Mathiesen is the overall ETR Document Manager, and can be reached via electronic mail at: **jmathiesen@trihydro.com**

**Richard W. Meehan** is on assignment from the National Nuclear Security Administration to the Environmental Management program of the US Department of Energy, as part of his participation in the Senior Executive Service Candidate Development Program. During his federal career, which started in 1992, Rich has served as Team Leader for Facilities and Materials Reuse, Environmental Restoration Program Manager at the Portsmouth Gaseous Diffusion Plant, and Surveillance and Maintenance Program Manager for the East Tennessee Technology Park. Earlier, he worked as Remedial Action Project Manager at Portsmouth, and as project manager/analyst. His expertise includes intimate knowledge of Y-12 facilities, recycling of metals, homeland defense equipment reuse, threat reduction, and detection of chemical, biological, radiological and nuclear threats. Mr. Meehan is a certified Federal Project Director, has a BS in Biological Sciences and a MS in Environmental Sciences from George Washington University. Mr. Meehan serves in the ETR Facility Reconfiguration Team, and can be reached via electronic mail at: **meehanrw@EM.doe.gov**.

**Frank L. Parker,** Distinguished Professor of Environmental and Water Resources Engineering and member of the National Academy of Engineering, is a pioneer in nuclear waste management and environmental protection. Over the past five decades, he has served as head of the Radioactive Waste Disposal Research Section of Oak Ridge National Laboratory, Head of the Radioactive Waste Disposal Research Program at the International Atomic Energy Agency, Senior Research Fellow of The Beiger Institute of The Royal Swedish Academy of Sciences and Senior Research Fellow, International Institute for Applied Systems Analysis (IIASA). At IIASA, he was the head of the Radiation Safety of the Biosphere Program that investigated radioactive contamination in the Former Soviet Union and in the Peoples Republic of China. Professor Parker has chaired or been a member of many national and international advisory committees including US Department of Energy's Environmental Management Advisory Board, Scientific Advisory Boards (e.g., Defense, Energy, and Environment), Project Officer of the Arctic Military Environmental Cooperation, National Research Council's Board on Radioactive Waste Management, many National Academy studies and various national laboratories. Professor Parker has also served as consultant to international bodies and countries including IAEA, WHO, UNSCEAR, World Bank, Belgium, France, Israel, Italy, Pakistan, Sweden and Switzerland. Dr. Parker serves as the ETR Facilities Reconfiguration Team Lead, and can be reached via electronic mail at: **Frank.L.Parker@vanderbilt.edu**.

**J. Winston Porter**, president of the Waste Policy Center, is a leading environmental and management consultant, whose recent experience includes solid waste management, hazardous waste site remediation, urban litter control, agricultural biotechnology, water resources, and global climate change. Winston frequently communicates through reports and speeches, as well as op-ed articles in numerous major newspapers, including the New York Times and the Wall Street Journal, on topics such as American and European waste management, agricultural biotechnology, federal facilities site remediation, radioactive waste management, urban rivers restoration, and improvements in the Superfund program. Dr. Porter served as Assistant Administrator for Solid Waste and Emergency Response at the US Environmental

Protection Agency, managing the national Superfund and RCRA programs, and ~$2B/yr. While at Bechtel, he directed the master plan for the $30 B Jubail Industrial City in Saudi Arabia, and served as a vice-president of several Bechtel affiliates in the Middle East. Dr. Porter received his BS (a "distinguished engineering graduate" from Univ. of Texas -Austin) and PhD (Univ. of California - Berkeley) in Chemical Engineering, and is a registered Professional Engineer. He also serves as presidential appointee to the Interstate Commission on the Potomac River Basin. Dr. Porter serves in the ETR Mercury Issues Team, and can be reached via electronic mail at: **www.winporter.com**.

**Richard B. Provencher** is Deputy Manager for the Idaho Cleanup Project at the US Department of Energy, with line responsibility for all Environmental Management program activities at the Idaho office. This includes management and safe operations involving spent fuel, high level waste, low level waste, Transuranic waste, and mixed waste, as well as RCRA and CERCLA activities, and a budget of ~ $450 M/yr. He is a member of the career federal Senior Executive Service. Richard served previously as Director of the Miamisburg Closure Project in Ohio, with responsibility for the restoration of the Mound site and transfer to the community for use as a high-technology business park. He is well versed in CERCLA, RCRA, contractor oversight, and working with the public in determining appropriate facility end-states. Richard also served as Deputy Director of the West Valley Demonstration Project, where he brought the treatment facility to readiness and managed the safe vitrification of more than 18 M curies of high-level radioactive waste. Mr. Provencher has a BS in Biology and MS in Health Physics. Mr. Provencher serves in the overall ETR Team and ETR Mercury Issues Team, and can be reached via electronic mail at: **Provenrb@ID.doe.gov**.

**William C. Schutte**, President of Delta G Technologies, brings extensive experience, managing technology commercialization, contractual, and technical consulting programs. Bill supported the *External Independent Review of the RPP WTP* and directed a $350 million applied RD&D testing and evaluation effort in environmental technology for the US Department of Energy. He brings applied experience in technology development and conduct of external peer reviews. Dr. Schutte's consulting relationships in environmental management include MSE Technology Applications, Inc., Thermo Technology Ventures, Inc., the National Energy Technology Laboratory, Idaho National Engineering Laboratory, and the US Air Force. Bill has also performed from bench scale chemical research, to extensive teaching at various universities (e.g., South Dakota, Iowa, California-Irvine, and Idaho). Dr Schutte holds degrees in Chemistry, Physics, and Mathematics (Wayne State College), Chemistry and Mathematics (Univ. of South Dakota), and a PhD in Physical Chemistry, Physics, and Mathematics. He is quite active in the American Chemical Society, and a member of the South Dakota Academy of Science, the Fine Particle Society, and Sigma Xi. Dr. Schutte serves in the ETR Mercury Issues Team, and can be reached via electronic mail at: **William.Schutte@mse-ta.com**.

**Aníbal L. Taboas** is an executive generalist who consults on environment, governance, and strategic risk management. His background ranges from nuclear CONOPS, to line management of national laboratories and programs, and conflict resolution. He led various regulatory and legislative initiatives, including changing the disposal limits for transuranic waste. Accomplishments in the federal Senior Executive Service have been recognized by the Vice President's Hammer Award, Secretary of Energy Gold Medal, the University of Chicago Medal for Distinguished Performance, and several Exceptional and Distinguished Service Awards. Taboas has a solid reputation for innovative resolution of regulatory and legislative issues, project management, diversity, and independent peer review. Aníbal actively participates in pro-bono activities, such as the Board of Directors of the Center of Excellence for Hazardous Materials Management, and of the Institute for Regulatory Science, editorial boards, and peer review (e.g., National Science Foundation and International Atomic Energy Agency. Dr. Taboas has a BS in Physics/Theology (Univ. of Dayton), MS in Physics (Indiana State Univ.), MS in Mechanical & Nuclear Engineering (Northwestern Univ.), a PhD *honoris causa* in Environmental Policy (UPAEP), and numerous publications. Dr. Taboal is Fellow of the American Society of Mechanical Engineers, edited The Decommissioning Handbook, and Chairs the International Conference on Environmental

Management. Dr. Taboas serves as the overall ETR Technical Lead, and can be reached via electronic mail at: **TaboasA2@ASME.org**.

**Douglas W. Turner** serves as consultant for Visionary Solutions, LLC, on spent nuclear fuel (SNF), remote-handled transuranic (TRU) waste, remote-handled low level waste, classified waste and environmental restoration. Doug has over thirty years of experience managing projects and program activities related to the Oak Ridge Reservation. Topical experiences include: retrieval of TRU waste from 22 trenches in SWSA 5N at Oak Ridge, repackaging and certification of spent nuclear fuel for shipment to the Idaho National Engineering and Environmental Laboratory, organizing and developing the Oak Ridge Spent Nuclear Fuel Program (including completion of a NEPA EA, and of SNF shipments to the Savannah River Site), planning for disposition of Special Case Low-Level Waste, and leadership of the TRU waste management program. Mr. Turner completed his undergraduate degree in Engineering Science (Tennessee Tech.), earned graduate degrees in Nuclear Science and Engineering (Virginia Tech.), and Engineering Administration (University of Tennessee), and is a certified Project Management Professional. Mr. Turner serves in the ETR Facility Reconfiguration Team, and can be reached via electronic mail at: **dturner@vs-llc.com**.